

A11105 983504

Reference

NBS  
Publi-  
cations

NBSIR 84-2878(R)

# Selected Articles on Microcomputers

U.S. DEPARTMENT OF COMMERCE  
National Bureau of Standards  
Institute for Computer Sciences and Technology  
Center for Programming Science and Technology  
Washington, DC 20234

May 1984



U.S. DEPARTMENT OF COMMERCE

NATIONAL BUREAU OF STANDARDS

QC  
100  
U56  
84-2378R  
1984



72-1  
05  
106  
U.S.  
84-2878  
1184

NBSIR 84-2878

## **SELECTED ARTICLES ON MICROCOMPUTERS**

Lynne Rosenthal

U.S. DEPARTMENT OF COMMERCE  
National Bureau of Standards  
Institute for Computer Sciences and Technology  
Center for Programming Science and Technology  
Washington, DC 20234

May 1984

**U.S. DEPARTMENT OF COMMERCE, Malcolm Baldrige, *Secretary***  
**NATIONAL BUREAU OF STANDARDS, Ernest Ambler, *Director***





## SELECTED ARTICLES ON MICROCOMPUTERS

### ABSTRACT

There is an abundance of information being written about microcomputers and related products. Often the reader is overwhelmed at where to begin. This document provides the reader with basic microcomputer information and provides a starting point for further examination of the subjects. The readings cover a broad range of topics including management and technical aspects of hardware, software, communications, and support.

Key words: communication, management, microcomputer, micro-mainframe connection, personal computers, selection, software



## SELECTED ARTICLES ON MICROCOMPUTERS

## 1.0 INTRODUCTION

This document provides a collection of readings to those involved in the selection, operation, and/or management of microcomputer systems. This effort in compiling references has been prompted by the growing interest of the Federal community in microcomputer systems and the overwhelming amount of information on the subject. The selected readings are intended to help the reader acquire basic information on microcomputers and provide them with a starting point for further examination of the subjects. This document is part of a continuing effort and is an update to a previous bibliography, "An Annotated Bibliography of Introductory Articles to Aid in the Selection of Small Computer Systems," NBSIR 82-2573, August 1982.

The articles selected cover a broad range of microcomputer topics, including managerial and technical aspects of hardware, software, communications, and support. The intent is to provide articles that are generic in nature, in that they are not product reviews, but rather discussions of features, techniques, and/or concerns associated with microcomputers and related products and services. Thus, the identification/discussion of a product within an article is not the prime emphasis, but rather a means of illustration. It is hoped that the value of the information presented here will not rapidly decay over time.

The document is comprised of reprints of articles from readily available magazines and journals which are considered primary sources for articles on microcomputer systems (Appendix). No claim to exhaustiveness is made. The articles were reviewed, evaluated, and selected as to their value in fulfilling the objectives of this document. It must be recognized that new articles on microcomputers continue to be published, and it is therefore impossible for this selected readings to include the most recent material. Because of the nature of this document, it is necessary to mention vendors and commercial products. The absence or presence of a particular product does not imply criticism or endorsement by the National Bureau of Standards or the author.

This document is part of a continuing effort to provide the Federal community with standards and guidelines, and advice, assistance, and information about the acquisition,

management, and use of small computer systems. The author invites comments and suggestions on this document, future selected reading efforts, and/or our microcomputer program activities. The author can be contacted at:

System Selection and Evaluation Group  
Institute for Computer Sciences and Technology  
National Bureau of Standards  
Washington, D.C. 20234  
(301)921-3485

## 1.1 DOCUMENT OVERVIEW

To aid the reader in locating areas (or articles) of interest, Section 2: Article Compendium is a listing of the readings selected for this document. The articles are divided into several general categories, and are preceded by the page number of the article as listed in Section 3 of this document. Although each article has been assigned to a specific category, it is possible that some of the articles might also be appropriate in other categories. The categories are arranged in the following order:

### 1. OVERVIEW

These articles present information related to the changing role of computing due to the use of microcomputers within an organization.

### 2. POLICY/STRATEGY

These articles address the issues and concerns associated with developing organizational strategic plans for microcomputer resources.

### 3. ACQUISITION

These articles discuss the methods and impact of acquiring microcomputer systems.

### 4. SELECTION

These articles describe a methodology to be used in the evaluation and selection of a microcomputer system.

### 5. HARDWARE

These articles describe various components of a microcomputer system, ranging from the microprocessor to various peripherals.

## 6. SOFTWARE

These articles cover a wide range of topics ranging from the procedural aspects of selecting and using software to a discussion of application software.

## 7. INTERCONNECTION

These articles address the needs, benefits, or methods for connecting a microcomputer to other computer systems.

## 8. ON-LINE INFORMATION

These articles identify and describe services available for the electronic dissemination of information.

## 9. SUPPORT

These articles discuss several of the microcomputer support activities that can or should be implemented by an organization.

## 1.2 ACKNOWLEDGEMENTS

Special thanks are extended to Shirley Radack of the Institute for Computer Sciences and Technology for her assistance in the preparation of this document.

The author acknowledges the assistance of the authors or magazine and journal publishers for granting permission to reproduce articles from their publications. The name and subscription address of the publications can be found in the Appendix.



## 2.0 ARTICLE COMPENDIUM

### 1. OVERVIEW:

page 10 "Smooth Sailing", Alan D. Mazursky, Computerworld: Office Automation, Volume 17, Number 8A, February 23, 1983, pp. 17-24.

Overview of microcomputing including discussions on technology, application and system software, communications, and management issues.

### 2. POLICY/STRATEGY:

page 15 "Corporate Moves With Micros", Frank D. Girard, Computerworld: Office Automation, Volume 17, Number 41A, October 12, 1983, pp. 13-15.

Discussion of key areas in the development of guidelines for the use of microcomputer systems.

page 17 "Breaking Ground", Walter Ulrich, Computerworld: EXTRA!, Volume 17, Number 48A, November 30, 1983, pp. 47-50.

Case history of how one company established a microcomputer policy.

### 3. ACQUISITION:

page 20 "Purchasing Micros", Aaron Goldberg, Computerworld: Office Automation, Volume 17, Number 32A, August 17, 1983, pp. 37,40,41,44,45.

Questions such as: Who is buying micros?, where are they coming from?, and what impact will they have?, are discussed.

### 4. SELECTION:

page 23 "Fear of Buying", Rebecca Houck, Desktop Computing, February 1983, pp. 46-48,50,51.

Description of a general, commonly used methodology for buying a microcomputer system.

page 27 "How to Choose a Portable", Stanley J. Wszola, BYTE, September 1983, pp. 34,35,44-47.

Explanation of portable systems and exploration of its various components.

page 31 "Multi-user Systems Offer Substantial Savings", Ken Pedersen, Desktop Computing, December 1982, pp. 48-50,52.

Discussion of the advantages, limitations, and related issues of multiprocessor systems.

## 5. HARDWARE:

- page 36 "Bit by Bit", Ken Sheldon, Desktop Computing, March 1983, pp. 18,19.  
Introductory explanation of the meaning and implications of 8, 16, and 32 bit microcomputers.
- page 38 "Purchasing Computer Power", Mark Phillips, PC WORLD, Volume 1, Number 4, May 1983, pp. 292-296.  
Outline of a cost/benefits approach to buying more memory or storage.
- page 43 "How to Choose a Printer for Your Personal Computer", Bruce Thatcher, LIST, Spring 1983, pp. 108-110.  
Limited discussion of printer types and capabilities.
- page 46 "The Basics of Modems", Kenneth R. Guy, Hardcopy, September 1983, pp. 84,86,90.  
Explanation of modems and how they work.

## 6. SOFTWARE:

- page 50 "Software Evaluation", Michael Hammer, Computerworld: Office Automation, Volume 17, Number 24A, June 15, 1983, pp. 53,54,56,58,59.  
Criteria for deciding what software is best for you.
- page 52 "Copying Computer Software: What Risks, What Penalties?", Personal Computing, May 1983, pp. 131,132,134.  
Discussion of copyright law and the legal implications of copying or modifying software.
- page 55 "Free Software: Is It Any Good?", James E. Fawcette, Personal Computing, January 1984, pp. 243,245,247.  
Discussion of public domain software; where to find it and is it of any use.
- page 57 "Choosing What's Best for Your Purposes: The Family Tree Of Computer Languages", Bernard Cole, Popular Computing, September 1983, pp. 82-86,88.  
Guidelines for understanding computer languages as well as a survey of several major/popular languages.
- page 62 "The Processed Word", Terry Tinsley Datz and F. L. Datz, Softalk, August 1983, pp. 49-53.  
Survey of various word processing program features.

- page 66 "Assessing Your Data Management Needs", Deward F. Sayle, Desktop Computing, March 1983, pp. 38-41.  
Discussion of data management needs and the kind of system required to satisfy them.
- page 70 "New Spread-Sheet Packages Do More Than Model", Alan Hirsch, Mini-Micro Systems, June 1983, pp. 205,206,208,211,212.  
Discussion of spread-sheet basics and the integrated spread-sheet packages.
- page 74 "The New Wave of Computer Graphics", Alexis Driscoll and R. Howard, Computerworld: Extra!, Volume 17, Number 48A, November 30, 1983, pp. 75,78-80.  
General discussion of graphic programs, features, and use as a management tool.
- page 76 "The Communicators", Larry Jordan, PC World, Volume 1, Number 5, June 1983, pp. 74,76,78,79-82,84.  
Examination of the most important features of communications programs.
- page 83 "Integrated Software: More Than Meets the Eye", Kathryn Cogswell Carr, Computerworld: Office Automation, Volume 17, Number 41A, October 12, 1983, pp. 16,17,20,23,24,26.  
Examination of what is meant by integrated software and how it is influencing microcomputing.
- page 87 "Fourth-Generation Lanaguages", Henry T. Cochran, Computerworld: Office Automation, Volume 17, Number 24A, June 15, 1983, pp.47-49,52.  
Overview of these software tools and how they aid in solving problems.

## 7. INTERCONNECTION:

- page 90 "Communicating with a Mainframe, Mark Levine and J. Williams, Popular Computing, April 1983, pp. 156,158.  
Introductory look at why a personal computer user would connect to a mainframe and how.
- page 91 "Finding a Proper Translation", Amy E. Smith, Business Computer Systems, Sept 1983, pp. 86,88-90.  
Discussion of the problems and solutions to exchanging information among different computers.
- page 95 "A Primer on Networking", Bruce Churchill, Softalk, July 1983, pp. 97-100,103.  
Discussion of local area networking fundamentals.



## 8. ON-LINE INFORMATION

page 100 "Information Utilities", Markoff and Shea, Infoworld, Volume 5, Number 13, March 28, 1983, pp. 41,42,44,46,47.

Brief introduction to electronically delivered information and the various types of services available.

page 102 "Videotex", Bernell Wright, Computerworld: Office Automation, Volume 17, Number 16A, April 20, 1983, pp. 65,66,68.

Overview of Videotex; what it is and how it can be used.

## 9. SUPPORT - Training, Security, Maintenance

page 105 "Information Resource Centers - Organizaing to Serve End Users", Thomas N. Pyke, Jr., Proceedings of COMPCON 83, Fall

Summary of the motivation for and issues associated with organizing to support end user direct access to computer resources.

page 109 "Computer-Based Training", Kate Barnes, Computerworld: Office Automation, Volume 17, Number 24A, June 15, 1983, pp. 64-66.

Discussion of the use and benefits of computer-based training.

page 111 "End-User Game Plan", Hugh Ryan, Datamation, December 1983, pp. 241,242,244.

Discussion of factors (training, 'coaches', software tools) that should be part of end-user computing strategies.

page 114 "Hard Facts on Hardware Service", John Butler, Desktop Computing, March 1983, pp. 60-62.

Practical advice about maintenance options for the care and repair of microcomputer hardware.

page 117 "Insecurity in Numbers", Fred W. Weingarten, Government Data Systems, July/Aug 1983, pp. 8,9.

Discussion of security and data control problems that arise from the use of office automation systems.

### 3.0 SELECTED READINGS

## 1. OVERVIEW

# Smooth Sailing

*The mainframe computer environment was where it began. But now it's smooth sailing for personal computers, particularly in the office.*

**By Alan D. Mazursky**

Microcomputers are producing a revolution in the way many of us function at work. Neither mainframe computer systems nor traditional word processing systems have had such an impact on our work lives. For the first time, users are finally getting control of their processing power. Business people are now using microcomputers as stand-alone or distributed "analysis" workstations, powerful WP systems, inquiry and data entry stations connected to mini or

mainframe processors and as full business (production and accounting) systems.

Frequently we forget that the capabilities we now have with microcomputers were not available even three years ago. Until recently, all processing and analysis had to be performed either on the organization's mainframe or mini-computer system or by hand in quill-and-pen mode. Microcomputers now allow many office functions to be performed at costs considerably lower than those involved with more traditional mini-computer-based office systems.

Microcomputers now are being used to handle many business office needs, such as:

- Word processing, including report preparation, list processing and data-base handling of abstracts, comments and briefs.
- Financial analysis, including budget and financial statement analysis, systems modeling and simulation, portfolio charting and modeling and cash flow and production forecasting.
- Mathematical analysis: statistics, linear programming, Pert

and CP/M (project or job stream control) and production and market modeling.

The above functions and others are being performed through microcomputer workstations in

***"The most important factor in determining the application of micros in the office is functionality. It is not the brand name or the biggest and best system that is important. Importance is gauged by what the system can provide for the users to make them better at what they do."***

- Color-graphics generation: Use of full-screen and hard-copy color graphics, creation of free-hand graphics using digitizing tablets, display graphic and textual material through automated presentation systems.

- Communications: participation in electronic mail networks, accessing remote data bases, inquiry/data entry to host mainframes, accessing public networks and functioning as local-area network workstations.

many organizations. These workstations can be used as stand-alone applications processors or as part of distributed networks, tied into the organization's systems, local-area networks and broader networks.

The most important factor in determining the application of micros in the office is functionality. It is not the brand name or the biggest and best system that is important. Importance is gauged by what the system can provide for

the users to make them better at what they do. Although 16-bit machines are here, many applications can be performed adequately and at a substantially lower cost with 8-bit micros. Similarly, many applications can and should be performed in a stand-alone configuration, while others dictate the need for a shared capacity (either multiuser or networked).

The 1980s has been identified as the decade of communications. During the coming years, the control, analysis and effective communication of information will be among the determining factors of an organization's health and viability. Much like controlling the factors of production was important for the industrial revolution, so will controlling the means of communication be important for the information revolution.

Micros are now being used to access many data bases available to the public, including Micronet, The Source and the Dow Jones News/Retrieval Service. These networks offer services, data and programs that can be used for



business applications. Other specialized network services are also offered, like Auerbach (computer-related information) and Lexis (law-related information). Also, many micro systems are currently being used to access the Telex network for transmitting important messages to other workstations on the network. During this decade, these network services will proliferate.

Micros are frequently the sending and receiving computers for communications networks like Telenet and Tymnet, which support data, document and electronic mail transfers. Although most micros currently communicate asynchronously at 300 bit/sec or 1,200 bit/sec, full use of the public packet-switched networks supporting the ISO Open Systems Interconnect architecture will require that hardware vendors embed X.25 communications protocol hardware in the next generation of microcomputer products. The use of X.25 protocols has the major advantage of guaranteeing end-to-end transmission of packetized data and therefore reduces the risk of receiving corrupted data.

A growing opportunity exists for organizations to take advantage of these public networks. Many companies are investigating the use of micros for collecting and communicating data (for example, factory orders) to various remote sites — domestically and abroad. These organizations have recognized that it is not necessary to use mainframes or minicomputers in situations where micros can be used effectively — and at a much lower cost.

In the move to put a workstation on every desk, we must consider how we want the system architecture to look from a functional standpoint. Do we want our workstations to have local storage and processing power while still communicating (implying a network design), or do we want to implement a multiuser micro environment (implying a more traditional minicomputer-type environment)?

Some of the larger microcomputer systems (such as those from Fortune, Altos Computer Systems, Inc. and Cromemco, Inc.) are capable of supporting a number of users on a single host "micro"-processor. Architecturally, these systems are very much like the minicomputer systems currently available. However, lower cost configurations are possible and it is possible to run many of the popular microcomputer software packages on these systems. They also share with minicomputers a basic drawback — if the host processor goes down, so do the terminals.

The organization require this type of architecture for its processing needs?" If a data base is shared frequently and there is a heavy processing load, this might be the correct choice. If the work load is sufficiently large, consideration should probably be given to the minicomputer level.

**T**he alternative of using a local-area network presents some interesting possibilities. A number of physical and logical design approaches are available for local-area networks and are described below.

#### □ Topologies:

- Star — Devices are interconnected through a centralized network controller.

- Bus — Devices are interconnected directly by cables and may pass thru nodal control points.

- Ring — Devices are connected in a circular (ring) pattern.

#### □ Cabling:

- Twisted pair — Essentially phone-line cable. Offers low cost and low-speed transmission (56K bit/sec).

- CATV — Essentially cable TV cabling. Offers high cost and high-speed transmission.

#### □ Communications control logic:

- Token passing — A device is allowed to transmit only when it gains control of a "token." Token passing is best suited for long transmission lengths and large message packets.

- Carrier sense multiple access with collision detection (CSMA/CD) — Devices monitor transmission line for a not-busy condition. Data transmission is monitored by device to determine if data packets have collided; if so, data is retransmitted. Suited for small-size data packets.

#### □ Capacity:

- Baseband — Offers transmission speeds up to 10M bit/sec. Assigns capacity of network to one transmitting device at a time. Offers low cost and is good for low-volume data traffic.

- Broadband — Offers very high-speed transmission. Is capable of supporting data and voice communication and supports concurrent device transmissions. Entails high cost and is good for high-volume transmission.

Two popular microcomputer-based local-area nets are Cluster One by Nestar Systems, Inc. and Omninet by Corvus Systems, Inc.; both use the twisted-pair architecture. One possible drawback of this type of network is that support is currently offered only for a limited selection of micros, which forces a hardware standardization. (In the larger sense, this may or may not be warranted).

Other micro-based networks now being implemented by many corporations include, among others, Digital Research, Inc.'s CP/Net and Zilog, Inc.'s Z-Net. Micros can also link into mini-based local-area nets such as Ethernet from Xerox Corp., Intel Corp. and Digital Equipment Corp.; Wang Laboratories, Inc.'s Wangnet; Datapoint Corp.'s Arcnet; Sytek, Inc.'s Localnet.

Many issues should be considered before a decision is reached on a network or multiuser implementation. These issues — such as work load, technological integration, functionality, cost/benefits and software availability — have always been the core of intel-

ligent DP decisions. As microcomputer applications become increasingly more sophisticated and complex, so, too, do the types of decisions we make about their implementation.

There is no quick answer as to which technological alternative to select, but the driving force should always be the strategic business need.

**M**icrocomputer software has already distinguished itself as being innovative, user-friendly and powerful. The available software includes systems for word processing, portfolio analysis, financial and production modeling (including simulation and forecasting), data base management and full-blown accounting systems. The acknowledged leaders in the marketplace show a flair for understanding what users need, presenting the system to users and maintaining reasonable pricing structures and — more importantly — quality.

The following popular applications have found a firm foothold in the automated office:

- Spreadsheet packages: These are the primary legitimizing factor for businessmen. They enable nontechnical users to "program" financial forecasts, budgets and so on. They also provide interfaces to graphics processors for such things as trend lines and pie and bar charts, and they are excellent for small modeling tasks.

- Financial modeling languages are used for complex models with large data files. They provide some integration of functions and are considerably more expensive than the spreadsheet packages.

- WP packages include most, if not all, of the features offered by mini-based WP systems and they are considerably less costly than traditional WP systems. They enable users to prepare reports (including spreadsheets, graphics and so on) without resorting to the typing pool or report department. They also allow users to transfer documents to and from many WP systems.

- Data base systems support users in complex tasks by presenting a logical (relational) view of data to the user; by absorbing the detail file/data management tasks, thus allowing the user to concentrate on managing the application, not the data; and by functioning as a very useful centralized data center for users connected on a local-area network.

Possible applications include financial and market modeling, document and brief abstracts, personnel assignment and client billing and integrated accounting systems.

- Graphics systems offer enhanced data presentation capabilities. ("Everything is in the delivery.") They also function as interfaces to data bases, spreadsheet packages and modeling systems.

- Communications packages provide communications protocol

support for asynchronous transmission (public networks), bisynchronous transmission and 3270-emulation and packetized transmission (for example, X.25 protocols). They also enable connection to public-access data bases, corporate mainframe host systems, other micros (point-to-point) and so on.

Over the past few years, the micro-software industry has experienced considerable growth both in numbers and sophistication. A shift has occurred from the cottage industry to the corporate environment. Software systems have blossomed from those with limited stand-alone functionality to those employing concepts of multifunctionality, integration and communication. (Table 2 provides a brief recap of the micro-software industry). The next few years should bring the implementation of truly integrated software (and hardware) systems. These systems will:

- Require little technical computer expertise. Users should not have to worry about brand of computer, type of operating system or management of data files (for example, details of I/O access methods or conversions).

- Benefit users who understand problem solving techniques and are not afraid to try new approaches.

- Integrate such functions as word processing, graphics input and output, automated slide-show presentation capabilities, voice recognition and synthesis and communications protocol support.

These types of packages are beginning to appear. For instance, Context/MBA and Micro-DSS:F display some of the integration features mentioned above. The current marketplace will show a radical shift over the next year — all for the better.

**T**he early 1980s has brought a natural evolution of hardware from an 8-bit world (Apple II, TRS-80, Osborne I, Commodore CBM, and so on) to the more powerful 16-bit microcomputers (such as the IBM PC, Fortune 32 16 and the DEC Rainbow). The following shifts are occurring:

- Main memory:
  - 64K bytes to 1M byte.
- Mass storage
  - Floppy diskettes (400K bytes) to hard disks (20M byte)
- Operating systems
  - Single to multiuser.
  - Uniprogramming to multiprocessing.
- Technology changes
  - 5 25 in. floppies to 3 in. rigid floppies
  - High-resolution screen color graphics
  - Use of digitizing tablets, touch screens, light pens, voice and so on as input devices.

From the perspective of functionality, organizations should not be concerned with the particular piece of hardware being used. Hardware is nothing but a com-



modity, like a record player or a typewriter. If the hardware and software satisfy a particular need and are consistent with the organization's objectives, then users should be given the latitude to acquire these support systems.

Of course, the key phrase here is "the organization's objectives." Management should always be looking toward the future needs of the organization. Consideration should be given to the possible requirements for integration and compatibility, as well as to the need for short-term expedients.

Many articles are being written on the dangers of proliferating different microcomputers and generating distributed data bases. These problems should be recognized and understood by management in the context of short-term and long-term goals. However, from a very pragmatic point of view, we need to recognize that, for many organizations, the current mainframe DP systems are barely able to produce the minimum information required to run the business, much less support management and staff with their analytical requirements. Often, users' requests for mainframe analytical systems are put into a backlogged development queue with delivery promised for two to five years down the road.

Therefore, we must support users who wait to implement their decision-support systems in the short term and not focus on long-range requirements to the exclusion of what can be achieved today using microcomputer technology.

**O**perating systems on the micro level have been important in determining users' and software vendors' acceptance of the hardware products. Basically, there are two types of operating systems: proprietary (like Appledos and Trsdos) and generic (like CP/M, Msdos and Unix).

Proprietary operating systems function on only one vendor's hardware, while generic operating systems will function on the hardware of many different vendors. Obviously, generic operating systems, in providing the ability to run the same compiled software on different vendors' products, have become important in determining the distribution channels for software and the popularity of hardware systems. It is reasonable to infer, then, that proprietary operating systems will have a difficult time succeeding in the marketplace unless the hardware has particularly good application software features. The implications for these vendors are clear.

Digital Research's Control Program for Microprocessors (CP/M) was the first of the popular generic operating systems available for 8-bit computers using the 8080 family of microprocessors (including Z80, 8086 and so on). CP/M was patterned generally after DEC's RSTS minicomputer operating system. It currently is available on over 200 models of microcomputers and has become the de facto standard for 8-bit operating systems. Many hardware manufacturers have been able to

***"From a very pragmatic point of view, we need to recognize that, for many organizations, the current mainframe DP systems are barely able to produce the minimum information required to run the business, much less support management and staff with their analytical requirements."***

bring their microcomputers to the marketplace very quickly because of the existence (and modularity) of CP/M and the general availability of software packages running under the CP/M operating system.

One of the great debates currently raging is "Is CP/M dead?" CP/M is often seen as the masthead of the 8-bit world, and this question arises because of the proliferation of 16-bit micros, which threaten to crowd out the 8-bit systems. The question really should be "Is the 8-bit world dead?"

The answer is "No!" at least in a two- to three-year time frame. Currently, 8-bit machines perform many functions very well and at a cost significantly below the 16-bit systems. It makes little sense to spend extra money for a 16-bit machine if all the functionality required for a particular application is on the 8-bit level.

Certainly, as prices drop, users will be getting more bang for the buck. Full-blown 8-bit machines will become available at lower prices; as a result, more organizations will be able to take advantage of the power of micros. The 8-bit world — and CP/M — should therefore be with us as the low-end market at least for the near term.

Looking to the rest of the '80s, we expect that users will not have to know which operating system they are using. The operating system will be increasingly transparent to the application and to the user. Several operating systems will probably survive on the 16-bit level, including CP/M-86, Unix and the UCSD P-System. These systems will provide the core for the stand-alone and distributed processing workstations of the 1980s.

**M**anagement surely recognizes that information and the means to get at that information constitute vital organization resources. As micros become more a part of OA systems, we must become acutely aware of both their power and limitations. In many organizations, management (including DP management) pays very little attention to the management of information and technologies or to supporting technological innovation.

The rapidly changing technologies require that those at the upper levels of an organization must become more familiar with the technologies and manage — not control — the spread of

microcomputers.

Many managers do not fully realize the implications of implementing micro-based OA systems. They assume either that goals stated in general terms can easily be translated into a microcomputer implementation (based on all the success stories appearing in the trade press), or that nothing should be implemented because the technologies have not yet matured. Management (and staff) must be educated regarding technological alternatives.

Further, management should not control the use of micros for OA; rather, the use of micros should be properly managed. Control implies limitation — the antithesis of the concept of a personal computer — and may well be resisted by users attempting to satisfy the requirements of their particular function in the organization. It is inappropriate to define the best hardware and software systems for an organization. The edict approach does not recognize the rapidly changing nature of the microcomputer industry.

To be sure, management should have real concerns about the use of micros. Most of these concerns should be addressed by policy statements. Microcomputers should be thought of as nothing more than office equipment, like electronic typewriters. Micros are only tools to be used by management, staff and support personnel. The acquisition of a micro should therefore be tied to a real business need and should be able to fulfill that need in a cost-effective manner.

Many microcomputers in the office will continue to be primarily stand-alone application systems — whether it be WP, financial or production modeling or forecasting. For these types of systems, management should set general policy guidelines for equipment acquisition. These guidelines might include such things as recommending (but not mandating) specific equipment for acquisition, purchasing procedures, training requirements and suggestions for packaged software.

For computers that will be connected to a host mainframe or interconnected via local-area networks, management must set both general and specific guidelines. For instance, data access and privacy issues must be addressed (and therefore, access to the network or host must be properly controlled). Also, physical access to the microcomputer hardware and data storage floppy

diskettes must be controlled in some manner (at minimum, by storing vital program and data disks in a safe place).

In all cases, management should support the education of employees with these new tools, encourage formal and informal corporate communications (including underground newspapers, if necessary) and inform the organization of changes in policy and major development projects under way.

The points to be conveyed to management are:

- There is a need to understand the rapidly changing nature of the micro technologies.
- There is a need for management to be flexible in dealing with the growth of micro technologies within their organizations.
- Access to information should be controlled, but the hardware/software solutions should be managed.

**M**icros are becoming firmly entrenched in our OA systems — whether as stand-alone or interconnected application processors. They have achieved recognition as truly functional workstations. Furthermore, the available software demonstrates an understanding of what users need to help them improve their work product.

The next two to three years we will see the widespread use of 16-bit machines and the introduction of 32-bit architectures. The 8-bit world is not dead; its universe, however, has been redefined. It will now serve the low-end, entry-level marketplace. The 3-in. rigid floppies will proliferate and the cost of hard-disk drives will plummet.

Software is moving toward supporting an integration concept in virtually every application area. Combining the new software technologies and support of many communications protocols will put microcomputers in the forefront of the multifunctional workstation marketplace. Micros will become an increasingly important part of local-area network implementations. Microcomputer-based graphics systems will become vital elements in the modern automated office.

Management will be responsible for supporting, if not spearheading, the proper implementation of micro systems in the office. This support will take the form of general and specific policy statements, providing technical support through the DP department, setting certain guidelines for purchasing micros and hooking into local networks or the corporate mainframe.

OA



APPLICATION	PRODUCT	VENDOR
Spreadsheet Packages	Visicalc Supercalc Multiplan Calcstar Target	Visicorp Sorcin Microsoft Micropro Conshare target
Financial Modeling	DSS:Financial Context/MBA FPL Finplan	Addison-Wesley Publishing Context Management Lifeboat Associates Hayden Publishing
Word Processing	Wordstar Vedit Easy Writer Word Juggler Scriptsit Word Handler Final Word	Micropro Compview Products Information Unlimited Quark Engineering Tandy Silicon Valley Systems Mark of the Unicorn
Data Base Systems	Dbase-II DB Master Datastar FMS-80 Condor	Ashton-Tate Stoneware Micropro Systems Plus Condor Computer
Graphics	Apple Business Chartmaster Visiplot Strobe EBS	Apple Computer Decision Resources Visicorp Strobe Lotus Development
Communications Software	Microlink Ancall Data Capture Micro-Courier Z-Term	Wordcraft Microcall Services Southeastern Software Microcom Southwestern Data Systems

Some Widely Used Micro Software Packages

TIME FRAME	DESCRIPTION
Late 1970s	Home-grown and limited-function software
Early 1980s	Packaged software, including: WP and electronic spreadsheets
Mid 1980s	Integrated software packages: single "systems" combining WP, graphics and modeling software

Development of Micro Software Technology

8-BIT	16-BIT	VENDOR	COMMENTS
Appledos		Apple	Proprietary
Trsdos		Tandy Corp.	Proprietary
Hdos		Zenith Data Systems Corp.	Proprietary
CP/M	CP/M - 86	Digital Research, Inc.	Portable, single user
MP/M II	MP/M - 86	Digital Research, Inc.	Multiuser
	MSDOS	Microsoft, Inc.	Developed for IBM Personal Computer
UCSD P-System	UCSD P-System	Softech Microsystems, Inc.	Very portable, uses concept of pseudo machine
	UNIX	Western Electric Co.	Originally developed for minicomputers
	XENIX	Microsoft	Unix look-alike
Oasis	OASIS - 16	Phase One Systems, Inc.	Single or multiuser systems

Available Operating Systems

Mazursky is a management consultant with the New York office of Deloitte Haskins & Sells. He works with clients in implementing microcomputers in their organizations, developing corporate policies and MIS strategies, and designing and implementing production, MIS and decision support systems. He is a member of his firm's microcomputer task force.

## 2. POLICY/STRATEGY



# Corporate Moves With Micros

Most major corporations are finding they can no longer avoid developing a corporate strategy for microcomputers. The pressure to set policy comes from two main sources within these large organizations: users who purchase micros on their own and forward-thinking management and DP executives who realize the growth of micro use should not go unattended.

In developing a strategy for effective utilization of microcomputers, corporate management faces many problems, including:

- Training relatively unsophisticated and nontechnical users to operate microcomputers effectively.
- Coordinating the processing of information at hundreds of different locations rather than at a few carefully controlled and administered processing sites.
- Ensuring the integrity and security of data created by microcomputers — data that is less secure and more available to personnel who may want to utilize it in a manner detrimental to the corporation. How can

**By Frank D. Girard**

organizations successfully address the issue of micro use? One way is to develop a plan that integrates microcomputing within the framework of the firm's overall business and information processing goals.

**A**fter an organization reviews its current information processing and business environment, a three-phase approach to developing this plan can be helpful: introduce microcomputer concepts to user departments; develop user operating guidelines; develop overall policies and procedures for effective management, from a corporate perspective, of the development and use of micros. The following checklist points out some key areas in the development of operating guidelines for microcomputer users within a large organization:

**□ What will be the primary objectives of microcomputer use in the organization?**

These objectives might include providing improved support for executive decision making, increasing the volume of clerical work performed with existing staff or improving the organization's competitive position in the marketplace.

**□ In which areas of the organization will microcomputers be utilized?**

Factors that might influence this decision are the potential impact on bottom-line profits; the urgency of the need to provide microcomputer support; the imple-

mentation cost for utilizing micros within specific areas; and the visibility to top management if areas selected for implementation are pilot test sites for microcomputing.

**□ How will users be trained?**

Will they be self-trained by means of vendor-supplied documentation? Will they be trained internally by the organization's training department? Or will training be supplied by the new breed of firm that specializes in microcomputer training? What will the training cost, and how will its effectiveness be assessed?

**□ What corporate resources will be supplied to the microcomputer users?**

What resources will be supplied for maintaining systems, evaluating new microcomputer software, diagnosing problems and assisting in the many other areas where microcomputer users will require assistance? Will micro resources be supplied by the DP department, the administrative department or another area of the organization?

**□ How will communications be handled?**

How can internal and external developments within the micro area be effectively communicated to users? How can duplication of individual user efforts in developing software or programs be prevented?

Several corporations have addressed this issue by establishing corporate computer user groups, microcomputer newsletters, technical libraries and even their own stores where users can shop for and evaluate hardware and soft-

ware that have been approved for corporate purchase.

**□ How will software and hardware evaluation and selection be handled?**

Will users be permitted to purchase their own micro hardware and software from a local computer store? If so, the result may be a lot of incompatible equipment, which would prevent computers from communicating with each other and from efficiently accessing data maintained on other mainframe computer systems. This purchasing pattern also could result in higher acquisition costs by not taking advantage of the combined purchasing power of the corporation.

Factors that could be used to evaluate hardware and software are capacity requirements; extent of vendor support; availability and quality of help functional incorporated in software; completeness and quality of system documentation and system and software training materials; software operating mode, such as menu-driven vs. command-driven software; the extent to which the software utilizes special hardware function keys; and the transferability of data to other software packages.

**□ Who will be responsible for data, program and system backup?**

What approach will be utilized to provide adequate back-up facilities for micro programs, data and individual systems so that key processing functions can be performed when system problems occur?

**□ Who will respond to user and technical problems?**

When users experience problems with microcomputer hardware and software, how will these problems be addressed?

Several corporations have an internal consulting group to assist in addressing these problems. In addition, many corporations have established a help desk manned by a knowledgeable individual who responds to requests for assistance. Such an approach often includes maintaining a log of user and technical problems so that the use of micros and related problems can be reviewed and monitored periodically.

**□ Will employees be permitted to take advantage of contracts and computer discounts negotiated by the corporation in purchasing micros for their own use?**

For larger organizations, these discounts can amount to 20% or more. Permitting employees to use corporate discounts for microcomputer purchases can help them to become more knowledgeable about their computers.

**T**he above areas are only a few examples of issues that must be addressed in developing effective operating guidelines for microcomputer users. In addition to these user guidelines, important policy and procedural issues must be addressed. If a corporate framework for managing the use of micros is to be established

These management guidelines include the following:

**□ How will data communications be handled?**

Will the corporation's micros be equipped with modems, which permit these systems to access, update and communicate with each other? If microcomputer data communications is permitted, will the organization allow micros to access and update mainframe data? How can the security and integrity of this type of processing be ensured? Will micros be permitted to access on-line information services such as Dow Jones and Dialog? How will the on-line access and communications costs related to these services be controlled?

**□ How can the use of micros be audited to ensure that data created on these systems is authorized, accurate and complete?**

The use of micros presents a unique set of auditing problems which cannot always be addressed by conventional computer

auditing techniques.

**□ Will microcomputer users be permitted to develop their own custom computer programs?**

If these programs are not properly documented and developed and if the programmer leaves the organization at a future date, the effort that went into developing the program may be of no value. Other users will have no method to maintain the program effectively.

**□ How will microcomputers be integrated into the organization's corporate information system?**

The corporate information system may include mainframe computers, minicomputers, word processors and corporate communications networks.

How will it be determined when a microcomputer is more suitable than a mainframe computer for a business application?

**□ How will microcomputer hardware be maintained?**

Industry estimates indicate

that outside maintenance contracts for micros can cost from 20% to 30% of the initial purchase price of the equipment.

**□ What will be the policy on portables?**

Will the corporation purchase portable computers for executives to use while traveling? What criteria will be used to authorize a user's purchase of such equipment? How will all micros owned by the corporation be physically controlled to discourage theft of these devices from the organization?

**□ Will micros be used as competitive weapons?**

Will the corporation utilize micros outside of the organization as a marketing tool — for example, by providing them to corporate customers as an added-value service?

Several major banks offer microcomputers to personal banking customers to provide banking at home. Other banks are offering micros to corporate customers to assist them in more effectively managing their cash flow by per-

mitting access to commercial customers' cash management accounts.

In summary, the era of microcomputing has arrived at the doorstep of major corporations. Will the problems that result over the next 10 years cause major corporations to look back with regret, or will the opportunities provided by microcomputers revolutionize American business in a positive way?

The answer won't be found in the capabilities of microcomputer hardware and software. Rather, it lies in the approach that corporations take today, in developing a well-conceived plan to promote the effective use of this new technology.

OA

*Girard is an OA consultant in the Data Systems Technical Consulting Services Group of the New York offices of Ernst and Whinney, an international certified public accounting firm.*



## MICRO MISSION

# BREAKING GROUND

**A BILLION-DOLLAR COMPANY IMPLEMENTS AN INNOVATIVE PERSONAL COMPUTER POLICY.**

**P**ersonal computing is so important that its implementation and proliferation cannot be left to chance. Individuals can now have powerful computing capability at their desks. At one time, computers were expensive, and people's time was less expensive. Today, computing power is cheap and getting cheaper. The economy of computing has swung dramatically, and this change requires a rethinking of how information resources are managed. It is wise for organizations to take advantage of the new economics and adapt to the personal computing trend.

Setting a personal computing policy is complex and has many implications. Here is a case history of how one company established its personal computing policy. It

**By Walter Ulrich**

involves a billion-dollar company headquartered in a major industrial city. Corporate and divisional office staff exceed 1,000 employees in the headquarters city. The company has over 20,000 employees and sells products throughout the U.S.

The company saw that personal computing offered great opportunities to improve productivity and effectiveness and to save money. It also recognized that deploying personal computers was complex and not without significant risk. Inaction was seen as an invitation to chaos.

The company has a substantial investment in software, hardware and training in an IBM mainframe environment. The applications development backlog was consequential. Over a year ago, the company established an office automation task force to review and evaluate the implications of office automation. The task force was composed of executives and middle managers representing the operating divisions, administration, finance, purchasing, data processing and other staff functions.

The issue of personal computers was one of several topics on the task force agenda. One of the operating divisions had already purchased two microcomputers. One was in a division manager's office. The other was used for division planning. Within the division, one forward-looking manager and one technically oriented staff member were internal champions for the personal computer. They used the micro extensively

***At the outset, members of the task force made three critical observations about personal computing. First, personal computers and office automation should become part of the company culture in a conscious and planned way, rather than in a chaotic and disorganized way. . .***

themselves and trained interested co-workers in its use.

In this nonthreatening and supportive environment, microcomputer use grew steadily. By the time the task force began meeting, the micro was being carefully scheduled so that it could be used by the many people who needed it. Individuals within the division and throughout the headquarters were requesting their own micros and were asking for personal computer support.

At the outset, members of the task force made three critical observations about personal computing. First, personal computers and office automation should become part of the company culture in a conscious

and planned way, rather than in a chaotic and disorganized way. Second, there is enough information available to make sound decisions about the implementation of a personal computer policy. Third, the company had never implemented a personal computer policy before. There were important technical, cultural and business issues involved. Outside expertise was seen as invaluable in light of the considerable impact micros were expected to have.

The company selected a consulting firm to assist in the office automation and personal computer area. The key criteria for selecting a consulting firm were competence, breadth of experience, complete independence and professionalism. References were checked carefully.

The consulting firm was given reasonable opportunity for data collection and was named as advisor to the office automation task force on matters of microcomputer policy. The firm was assigned to advise the task force on its full range of alternatives, and the task force would make the policy recommendations to the corporate officers.

Thirteen issues that merited consideration for this particular company were identified. These issues included initiation, justification, product selection, compatibility, procurement, implementation, training, programming, maintenance, user support, monitoring, control and general education.

While each of the issues was important to this company, four issues

***. . . Second, there is enough information available to make sound decisions about implementing a personal computer policy. Third, the company had never implemented a personal computer policy before.***

required considerable attention and discussion. Each of these are discussed below.

Perhaps the most critical question in any company is who will be responsible for monitoring and implementing personal computing. In every company, there are four groups, each with an important role. These groups are the information systems department, communications, end users and office administration.

Personal computer evaluation, selection and implementation are complex technical undertakings. In general, the information systems department has the charter to understand and implement information technology.

While many personal computers are used on a stand-alone basis today, it is clear that they will need to communicate tomorrow. The communications will be to the corporate main-

Computerworld/Extra



## MICRO MISSION

frame, to specialized minicomputers, to public data bases, to other personal computers and to a variety of other services. The ultimate success of micros depends on establishing an adequate communications infrastructure. The communications function can play an important role.

End users have been the personal computer pioneers in many companies. Personal computers are confusing to them in some ways, but end users see the need and understand the benefits. They are demanding personal computing. As pioneers, they have had direct control of their micros. Now that microcomputers are becoming accepted, it is no wonder that end users are reluctant to give up that control to a staff organization.

Office administration has been serving the needs of the office and clerical worker for a long time. Office services people understand the needs of the professional, administrator, secretary and clerk. They have been focusing on the individuals' requirements for decades and can claim insight of the culture into which microcomputers must be

placed. Their job has been thankless at times, but they have learned how to be responsive on a personal level.

In the subject company, as in most corporations, the pros and cons of who would be responsible for personal computers were complex. The information systems department had genuine interest in micros. At the same time, information systems was implementing a major new system that was seen as essential to accomplishing overall corporate goals and objectives. The applications development backlog was already substantial. In addition, the information systems department had developed procedures for handling the big systems projects. Resources were already in short supply, and the information systems department was not oriented to serving individual users.

In this company, communications responsibilities were divided among different departments. Therefore, no communications department was positioned to play the leadership role for personal computers.

End users were the first users of micros. They did not want their use to be impeded or obstructed in any material way. At the same time, the users recognized that resources had to be made available to nurture and support personal computer users

companywide. The user divisions were willing to share some control over personal computing if they were provided specialized support and greater assistance.

Corporate administration and other staff departments were the first in the company to identify the need for overall office automation planning. The administrative staff examined many of the personal computer alternatives and were early supporters of micros within the company. They had been a catalyst in the formation

***End users have been the personal computer pioneers in many companies. Personal computers are confusing to them in some ways, but end users see the need and understand the benefits.***

of the office automation task force and had exercised leadership in evaluating advanced office technologies.

The issue of responsibility and control was ultimately resolved. Cur-

rently, the chief administrative manager is responsible for implementing microcomputer policy, setting micro standards and providing micro support to the end users. The information systems department provides the technical and advisory staff to support the end users. The division executives have the final authority for the implementation of micros within their division. These executives also have the ultimate responsibility for monitoring personal computer use.

This approach does not fit every company, but answers all the major concerns of this company. The decisions for control of personal computers fit the corporate culture and match the skills of the different individuals. The administrative executive ensures that micros address the needs of the individual office worker. The information systems department provides qualified technical employees.

Personal computer technical staff stay on the information systems staff to ensure that an adequate career path is available and to provide added technical guidance. While this kind of dual reporting would be a nightmare in some environments, it works well for this company.

The division managers are held

accountable for their respective division's performance. It was agreed that their authority must be final with regard to micros within their divisions. In practice, division management will look to the personal computer support staff for guidance. Division management will not often overrule the support staff as long as the support staff has the proper business and service orientations.

Another major question that arose was whether to standardize on a single micro vendor, select a few standard products or open the door to any micro that best meets the needs of a particular application.

Selecting a single vendor had both advantages and disadvantages. A single vendor would greatly simplify training, concentrate support skills and offer purchasing leverage. The ability to tie the micro together in the future would be greatly simplified, and the problem of accessing the mainframe would only have to be solved a single time.

On the other hand, a personal computer that is good for one task may be unsuitable for others. As technology evolves, integration problems that look awesome today may soon become trivial. One vendor may not be able to address all the company's needs at a reasonable price.

The company's policy decisions with regard to stan-

dardization are similar to those made in some other companies. The approach has broad applicability. A small number of products are approved as standards. Products are then chosen from the approved list to meet specific applications needs. The technical staff reviews new products and recommends changes to the approved list when it is necessary to do so.

In the event a job cannot be accomplished practically from the approved list, there is a mechanism established to allow deviations from the list.

Purchasing is assigned the responsibility to procure the hardware and expedite its delivery. Purchasing is acquainted with the applicable technologies and is expert at negotiating the best terms.

The company had traditionally viewed every purchase with great care and deliberation. How much justification would be required and who would be responsible for putting the justification together?

The task force recommended that several personal computer requests by end users be approved on a commonsense basis without formal justification. The feeling was that more experience with personal computers in end-user departments was needed before the full benefits could be appreciated. After this experience, it would be easier to list the benefits and justify the micros.

The task force felt that it could not infringe on the divisions' authority to establish its own justification procedures after the initial personal computer placements were made. The end users would be responsible for making their own case to their own division management. The personal computer support staff would advise and assist the users, but it was the requester who was responsible for getting approval.

The consensus of the task force was that too-elaborate justification would be detrimental. Since each part of the company was represented on the task force, it is expected that micro requests will be encouraged and that the justification efforts required will not be disproportionate to the size of the investment.

The company decided to offer micro support through a corporate personal computing center. The primary objective of the personal computing center was to serve end users by:

- Helping evaluate micro solutions to end-user information problems.
- Providing personal computer training and simple support to the end users.
- Making personal computers available so that end users could test drive them.
- Monitoring micro developments.
- Offering a sympathetic ear and helpful hand to users with personal computer

problems.

The personal computing center could be characterized as a personal computing store within the company. Users could get specific information or they could browse. A micro hot line was also implemented so that a frustrated user could telephone with a question while still sitting in front of his microcomputer. Finally, some services from the information center concept would be made available to help meet

***Today, the company has a personal computer policy in place. Microcomputer use is encouraged, and its benefits are expanding. It is expected that micros will ultimately be an integral part of the information/office architecture.***

some of the end-user computing needs that were poorly suited to personal computers.

Today, the company has a personal computer policy in place. Microcomputer use is encouraged, and its benefits

are expanding. Since the policy was established with an eye toward overall office automation objectives, it is expected that micros will ultimately be an integral part of the overall information/office architecture.

The key elements of this company's policy-making success can be summarized as follows:

- Establishing a high-level task force representing all the parts of the company and dominated by no single division.
- Seeking the assistance of experienced, professional and objective consultants.
- Understanding all the issues and exploring all the options before trying to make any decisions.
- Discussing the critical decisions openly and eliciting the views of all interested parties.
- Putting the policy and first-level procedures in writing, explicitly assigning specific authority and responsibility.
- Keeping a broad perspective and considering the implication of other information, communications and office technologies.

Microcomputers can and should be a powerful tool in your company. They are so important that they must be implemented in an intelligent and forward-looking way. The development of a corporate personal computer policy is essential. ♦

Ulrich is president of Walter E. Ulrich Consulting, Houston.

### 3. ACQUISITION



# Purchasing Micros

No one is surprised anymore to see microcomputers appearing with greater frequency on employees' desks. But questions about how the product gets from the factory to the user's desk have not yet been fully answered. The acquisition question is critical, not only from the important budgetary standpoint, but also from future support, software and integration standpoints. There is no single best way to purchase microcomputers. The individual needs of a corporation will dictate the best method of acquisition.

Most corporations with more than 1,000 employees now have some committee or job function with the set

purpose of determining what personal computers to use, who gets to use them and how to use them. Management information systems (MIS) has the critical role in this process. Not only does MIS have computer expertise, but also it will necessarily be involved in a few years, when these users want access to the host. One key part of any successful plan for implementing personal computers will be directing purchases and resultant support and service issues. As the number of dollars spent on personal computing increases, it will be necessary to have detailed plans in place in order to maximize discounts and minimize related costs.

## By Aaron Goldberg

The most striking development in this large corporate market in the last 12 months has been the speed with which these organizations have learned, planned and started to implement personal computing. During June of 1982, at least half the large corporations in an International Data Corp. (IDC) survey had no plan for personal computers in place; of this group, many had not even developed a committee.

Exactly one year later, the situation has totally changed. Fewer than 10% of all large companies are without a written plan for personal computer usage; of those without this blueprint, nearly all are developing one for implementation in the next year at the latest. Despite moving at

number of personal computers are often in use in the corporation — and without sanction. Although this trend is abating, especially in companies with proactive MIS groups, eliminating end-user purchases is almost impossible.

**Buying Patterns for Corporate Personal Computers:** The corporate customer can purchase personal computers (both multiple and single units) from a number of different places. Figure 1 shows the source of personal computers for corporate customers for both 1982 and 1983. This data is evidence that more and more personal computer purchases are being made from resellers and fewer from the direct manufacturer sales force.

largest percentage of sales to the corporate environment will go to the direct sales force of the manufacturers.

Two trends support this: the growing discounts available to those who order large numbers (more than 200) of personal computers, and the trend toward mandating personal computer use among professional and technical employees.

As fewer systems are purchased on an ad hoc basis, the big losers will likely be the retailers and dealers. The overriding comparison that will guide users in choosing one channel over another will be low price/low support vs. high price/high support.

**Relative Pros and Cons for Different Channels:**

Deciding on a distribution channel for the purchase of a personal computer will have far-reaching effects on the use, support and price paid. Each channel of distribution has strengths and weaknesses.

As the market for personal computers in the large organization exploded, cognoscenti agreed that the direct sales force would have the easiest time selling to the large user and that the IBM salespeople who had had the account for the last 20 years would be hard to beat.

The direct sales force has important advantages: They should be able to offer the lowest price — after all, they do build the box. In addition, the direct salesman has account knowledge; he knows your operation and what you

need. He also represents a large organization that will support the user and provide maintenance.

These three strengths would seem to provide answers MIS employees seek, but there are problems. Delivery of systems can take anywhere from two weeks to three months. Also, when the salesperson is not around, who can you go to? Telephone tag can present untold miseries when the vice-president of finance's personal computer is the one that breaks or that needs extra memory.

**Dealer/Distributor:** These sellers generally offer a higher level of expertise than that available from generic retail stores. Most offer a limited range of products and are well versed in these products.

the high level of support and training.

**Retail Computer Store:** The retail store is certainly the most visible channel for the purchase of personal computers. Many single systems purchased in an ad hoc manner are obtained from computer stores.

The retail store is often "handier" than other channels and does offer some important advantages. The support and service they offer are not at the same level as the dealer's, but nevertheless are highly useful. In addition, users can take advantage of the storefront operation and go there to expedite service, supply or add-on needs.

Most computer retail stores offer a broad range of products, and this can

Source	1982 %	1983 %
Direct Sales	90	47
Dealer/Distributor	10	50
Retail Store	30	31
Other	—	4
No Answer/Not Sure	7	16

Figure 1. Source of Micros

the corporate equivalent of the speed of light, however, users continue to purchase personal computers on an ad hoc basis.

The time and expense companies spend developing these plans would seem to indicate that methods and sources for buying these systems are written in concrete.

This is most certainly not the case. IDC research has shown that, for all the personal computer inventory the MIS group lists, double or even triple this

The implications of this trend are important. Although the headlines tell of thousand-unit purchases and million-dollar deals, the preponderance of resellers in the charts indicates smaller deals are still more common. In fact, the large increase in dealer business is very indicative of the importance of local support and service.

When this data is collected for 1984, the percentages will undoubtedly have changed even more. At some point in time, the

**Deciding on a distribution channel will have far-reaching effects on the use, support and price paid.**

These resellers have the advantage of being highly versed in the personal computer products and they offer a high degree of support. In addition, some degree of customization is available, as well as specific training and maintenance.

The primary drawbacks center around the cost of the systems and the stability of the dealer/distributor. These can be important deficiencies, but they are occasionally offset by

be important to the organization that wants to offer more than one or two systems. Some stores are willing to give a discount on total purchase value regardless of who manufactures it.

The drawbacks to the retail store should also be noted.

Most stores do not offer the high level of training and support many users will demand, and equipment service is usually done on a depot basis. In

## FOCUS

addition, the viability of the specific computer store has yet to be proven.

One wild card exists in the area of distribution — the in-house computer store. It could be the best answer for a number of large organizations. Gillette Corp. has been a pioneer in this area and is a good example of implementation of the in-house computer store alternative. The in-house computer store offers a number of benefits. Service and support are now under the direct control of the organization, as is training, which can be critical for implementation success. From an organizational synergy standpoint, one benefit truly stands out: MIS will be involved and knowledgeable about personal computers because in most cases, *MIS runs the store*. From the corporate political standpoint, the benefits are twofold. MIS is perceived as being responsive to user needs, and MIS is given more resources to perform this larger job.

However, the in-house computer store does have drawbacks. The costs involved in setting it up are usually quite large. Staffing can become a problem, especially if in-house employees have to be trained and educated. In addition, if the store "experiment" turns into a fiasco, it may leave the MIS department in a difficult position.

### **Buying Personal Computers**

It is not uncommon for the same package to differ greatly when used on two different systems — function keys, commands and device addressing are common problems.

Although rare, corporate licenses are sometimes available for some software products, and a one-time \$20,000 fee is a clear savings when contrasted with 100 copies of a \$300 program.

Programs can be quality tested. Good products can then be endorsed; if problems are found, it can be recommended that those programs be avoided. A planned method of disseminating this information is far better than relying on word of mouth.

Centralized buying also provides an important lever with the software company. Corporate accounts

**Centralized buying provides a lever with the software company, resulting in a higher level of support.**

are critical, and software firms are likely to provide a higher level of support to an organization that bought 100 copies of the program than to an individual who bought one copy.

	Mandate	Recommend	Ignore
Hardware	Only hardware used is provided by MIS	Certain models or vendors are suggested	Anything goes
	No end-user developed	Some end-user developed	Some end-user developed
Software	Limited number of packages offers	Reliance on package software	Package software used
	Some MIS-developed software	Little MIS-developed software	No MIS-developed software
Support	MIS provides Significant support	MIS provides Some, but not all support	MIS provides no support
MIS Involvement	MIS controls every aspect	MIS and end-user share control	User controls all aspects

**Figure 2. The MIS role**

**and the Role of MIS:** The most important part of deciding upon a method of purchase for your organizations' personal computers is assessing the MIS group's role in relation to personal computers. Three distinct paths are open for the MIS organization: Mandate, Recommend and Ignore. In the Mandate plan, MIS approves everything, and systems are allowed only as MIS dictates — in short, MIS controls every aspect.

In the Recommend plan, MIS

provides some urging and reasons for following suggestions, but users are allowed to make some determinations on their own. The support carrot is the tool most often used as a spur by MIS.

Under the Ignore plan (also known as the Ostrich approach), personal computers are totally ignored. Three years from now, when the 500 different personal computers become part of the distributed resource system, MIS will realize this was not a good plan.

These short names imply a great deal; Figure 2 contains a more detailed outline of each of these approaches. It should be understood that certain approaches will work for some companies and not for others. These approaches may differ, but certain undeniable truths cannot be ignored. In nearly all cases, large corporate purchases are far less expensive than ad hoc purchases on a per-system basis. Integrating 10 different types of systems is easier than integrating 100 different models. Both for the present and future, key areas are cost and integration, and improvements in these areas cannot be ignored.

MIS cannot wait and let collective wisdom dictate exactly how personal computers will be bought and used. MIS must be proactive so that the personal computers that are installed are installed successfully, and all economies are taken. This is easily possible under both the Mandate and Recommend options. Companies that choose the Ignore strategy should at least reevaluate their options.

**Impact on Software:** The impact of centralized vs. decentralized buying can easily be seen in the software environment. A number of benefits obtained from centralized buying are reflected in software:

Training is far easier when only one version of the package exists.

## FOCUS

From the end-user standpoint, it is very efficient to be able to give a fellow employee a copy of your diskette with the information on it and to allow that employee to manipulate it. Diskette sharing can almost be a primitive form of a network, a physical packet. In addition, it is comforting to know that if my program disk crashes, someone reasonably near me has a copy of the same program for the same system.

MIS can also develop for the program add-ons or forms — for example, a Visicalc template — that can be used by many of the prospective and present personal computer users.

Centralizing buying has numerous advantages from the software standpoint. Although the number of options available to

users may be limited, savings are not yet fully dependent on their systems. In time, the professional's personal computer will be as important as the MIS 30 series.

Centralized buying provides important advantages in maintenance. If only a limited number of models are purchased, MIS can possibly stock systems to be used as spares or even to be cannibalized for parts in the areas mentioned above often outweigh this disadvantage.

### **Effect on Service and Maintenance:**

Because most systems are relatively new and repairs are minimal, service and maintenance problems of personal computers have not yet assumed the importance they will in the coming years. Also, users

the necessary board or component. Some organizations are training their own employees in personal computer maintenance, so that service is also done in-house — a concept that fits very well with the in-house computer store.

In summary, the benefits of centralized buying can be very large for some organizations and the costs saved substantial. However, each plan must work synergistically with the organization it serves. Centralized buying will work for most companies, but it must be tailored to provide the best results. **CA**

*Goldberg is research manager of information systems at International Data Corp. in Framingham, Mass.*



## 4. SELECTION



# Fear of Buying

*Rebecca Houck may not be starting up where Erica Jong left off, but she does intend to remove, once and for all, the intimidation and uncertainty surrounding your decision to buy a computer system. Don't begin by selecting models—first analyze your needs and examine your reasons for believing that computerizing your procedures will aid your business. We doubt you will find a more thorough and systematic treatment than the one offered in this guide.*

If there exists a business professional who is not intimidated by the sight of a computer salesperson, I have yet to meet him. Managers and small business owners who are looking for computer systems generally perceive computer salespeople with a mixture of fear, suspicion and contempt. A common complaint is, "They are trying to sell me something I don't need." I won't argue with this. After all, a salesperson's job is to sell. But whenever I hear this complaint, my immediate question is this: if they sell you something you do not need, whose fault is that?

"But I'm not a computer expert," the business manager will argue. "How am I supposed to know which computer is best?" Well, let's back up a step. Maybe business professionals are not asking the right question. Instead of asking "which is best?" they should first ask themselves "best for what?" What do you, as a business owner or manager, want out of a computer system? This might seem like a pretty simple question, but in practice it is far from trivial. It is also where many fail when buying their first computer... or even their second or third.

## Think about it

You would hardly expect a large corporation to buy a multi-million-dollar computer system without having clear objectives and a master plan. In order to ensure that the company gets a system that meets all its needs, extensive studies are done to "define requirements" and translate them into "system specifications" for a computer that will do the job. The penalty for not doing such studies would likely be wasted dollars for an inadequate system, which will end up not being used by the people who should benefit most.

Of course, a small business is not a multi-million-dollar corporation. But

your dollar investment in a small computer system is every bit as important to you as that company's millions are to it. To protect that investment, you owe it to yourself to take as much care in choosing a system as that company would. Yet very few would-be computer buyers take the time to examine their actual needs when shopping for the "right" system. The result is often a lot of frustration when the eventual product does not live up to expectations.

## Very few would-be computer buyers take the time to examine their actual needs when shopping for the 'right' system.

So what is the answer? Companies and organizations in the private and public sectors have found it in their interests to adopt formal methodologies for evaluating and selecting computer systems. These methodologies, though called by different names and using different terminology, all consist of a well-defined set of steps to follow when buying a computer. These steps are designed to ensure that the buyer (1) knows exactly that s/he wants and (2) gets it.

In a very large organization, these steps can take many months of effort. In a small business, they might take weeks. As a rule, the time and effort involved would be proportional to the size and complexity of the organization and the system.

The following, then, is a description of a general, commonly used methodology

for buying a computer system. This methodology is applicable to any size system and organization. More importantly, it allows the business professional to determine and describe his or her needs in terms of business functions, not hardware and software.

## Step 1—define your objectives

You may have a set of objectives in mind when looking at computer systems. Put these objectives into writing and examine them carefully. Are they specific? Are they measurable? An objective such as "more efficient handling of accounts" is next to useless. The term "more efficient" offers nothing to aim for and gives no measure to determine if a system meets the objective.

A good objective is one that can be expressed in numbers or some other concrete terms. For instance, an objective might be to tighten inventory control to allow a ten percent reduction in the number of parts kept in stock. Or an objective might be to cut sales-order-processing time in half.

Often a business professional does not have enough familiarity with what a computer can do to be able to determine specific objectives. One of the better ways to learn about this is to visit other companies that are already using computers for similar jobs. By looking at the operation, how data are entered, what kinds of reports are produced, what tasks are being performed by whom, and so on, you can get an idea of how a computer would fit into your company. Ask others about the problems they have encountered and the lessons they have learned. Time spent in this way can help you to establish some reasonable objectives and a viable course of action.

## Step 2—identify constraints

Any constraints on your choice of sys-

tem should be identified at the outset. The most obvious constraint is money. An analysis of the company's budget should be done with an eye to how much of that budget can be allocated to a computer system. A point to remember in this type of consideration is that the cost of a computer system does not stop at the one-time purchase of the system. Consumables such as printer paper and floppy disks will become a permanent part of the budget.

Other constraints besides the budget may influence your choice. The nature of your business may require filing certain types of reports with government agencies, auditors, and so on. You might also do well to check any Internal Revenue Service restrictions on computerization of accounts. When putting your business on the computer, you should consider anything that restricts the way you do business.

### Step 3—analyze your work load

In order to decide how large a system you will need and what kinds of peripheral devices (e.g., disk drives and printers) you should have, you must first know what work your system will do. An analysis of your work load involves examining your current operations and determining what processes are done, how many transactions are handled, how often various transactions are processed (hourly, daily, monthly), and so on.

By going back through past records, you should be able to determine that you sent out, for example, 100 invoices a month on an average. Your invoices averaged about 5.3 lines with an average of 30 characters per line. Knowing this will help to determine how fast your printer must be to get all the invoices out, as well as how much storage you will need to hold the transactions being processed.

You will also need estimates of file sizes. How many accounts, how many customers and the size of inventory are a few numbers you will need to help you and the salesperson decide how much storage capacity you will need and how much information the system will be expected to handle.

Analyzing your work load will help to communicate to the salesperson the capabilities and capacities you will need. But the analysis is only half the job. To be sure that your system is useful for a number of years, you must allow for growth. Therefore, the current work load must be projected into the future to predict how fast it will grow in the next few years.

One approach is to use statistics from

past years to determine a rate of growth, then carry that rate of growth into the future. For instance, if two years ago you averaged 80 invoices a month, last year you sent out 96, and this year you are averaging 115, you can translate this into a 20 percent growth rate. Next year you may expect to average approximately 138 invoices a month. Of course, such analysis has to be done with an eye to factors that could affect the rate of growth. Such factors might include recession, competition and industry trends. An estimate of these factors is an educated guess, but it could help you avoid outgrowing your system in a year.

### Step 4—estimate the benefits

Benefits from a computer system are either quantifiable or non-quantifiable. To justify the expense of purchasing the system, you should be able to calculate some savings or revenue increase. These quantifiable benefits can be weighed against the cost of a system to decide if it is a good investment.

First, you should analyze your accounting operations and inventory to identify those benefits that can reasonably be expected. A thorough analysis would then involve multiplying the estimated benefit by the probability

## Checklist items

### 1. Does the system have adequate storage?

First, you must have sufficient main memory to hold the largest program you will be using. Most software packages have a minimum memory requirement, so be aware of it. Second, you must have sufficient disk storage to hold all the records necessary for processing.

### 2. How long does the system take to process a typical batch of transactions?

Systems vary in their processing speeds, both because of the speed of the processor itself and because of the efficiency of the program.

### 3. Can the system be easily expanded?

At a later date you may want to add more disk drives or upgrade to a faster printer. Systems vary in the ease with which such improvements can be made.

### 4. How reliable is the equipment?

Many components of computer systems have associated "mean time between failure" (MTBF) statistics. This will give you an average for the life of the component before repairs will be necessary.

### 5. What kind of warranty is included, and what does it cover?

Some may include parts and labor, while others do not. Mail-order systems are particularly limited in the warranties given.

### 6. How long has the system been on the market?

Although it is often tempting to get the most state-of-the-art equipment, new systems are often full of bugs. These bugs are usually discovered by customers and reported to the vendor for correction. If you do not want to be part of the debugging period on a new system, it is best to go with older, proven systems. (Older in the computer world, by the way, is measured in months, not years.)

### 7. Does the system perform the required functions?

Make sure you have a list of the functions you require for your operation.

### 8. Is the system easy to use?

The term "friendly" is used to describe how easy the system is for inexperienced users to learn and use. Does the software provide easy-to-use prompts, menus and directions? Does it require an inordinate amount of memorization of obscure mnemonics and commands? Is the screen easy to read? Is the keyboard easy to use? This is where the person who will be interacting with the system should get involved. An important consideration is how easy the user's manuals are to read. System documentation can run anywhere from good to really rotten. Sound documentation is very often an indication that the system is respectable.

### 9. What is the system cost?

System cost includes not only the total cost, but also the costs for supplies and maintenance.



## Selection

that that benefit will be realized. This figure, then, is your probable benefit from computerization.

For example, if you were to achieve your objective of reducing the parts in the inventory by ten percent, this may translate into a savings of, say, \$5,000. You are not certain that you can actually accomplish this, however, so you are willing to give it an 80 percent probability of success. Your probable benefit in this case is \$4,000 (i.e., 80 percent of \$5,000). This is the figure you would use to compare benefits versus costs in various systems.

Not all benefits are so easily quantifiable, of course. Suppose you could serve customers faster or offer a new service not currently available. How much would this benefit your business? Although these types of benefits cannot be expressed easily, they can be very important in deciding whether to buy a system. Try to identify as many of these non-quantifiable benefits as possible, and make a list to help you evaluate what a new system has to offer.

### Step 5—explore the alternatives

In this case, the term "alternatives" does not simply mean an Apple versus a TRS-80. Many options are available to a business manager planning to computerize. One alternative, for instance, is not to buy a computer, but to subscribe to a computer service. A timesharing service offers all the advantages of computerization without the responsibilities of supplies, maintenance and programming. Timesharing can be expensive, but it often offers more services and flexibility than you would have with your own system.

---

**Whether you are alone or with an expert, insist that the salesperson talk in your terms.**

---

Before purchasing a new system, you should investigate another alternative—rental. The low cost of microcomputer systems will generally make rental too expensive as a long-term solution. Short-term rental, however, is an excellent way of trying out a new system without making the commitment to purchase. Most dealers who rent systems have lease-to-

purchase options that allow rental payments to go toward the purchase price. This is a good way for you to decide not only which system is best, but also whether computerization benefits your business. It can also give you a tremendous psychological lift by lessening the "fear of failure" in installing a new system, since failure does not mean as great an economic loss.

The final alternative, and perhaps the most important to consider, is the "do nothing" alternative. After you have analyzed the business so far, you should ask yourself, "Do I really need a computer?" If you do not feel confident that a computer will help your business, perhaps the best alternative is to wait a while.

### Step 6—write system specifications

System specifications are simply those features that you want to be included in your system. These are derived from your work load analysis. System specifications serve to communicate to the salesperson exactly what you need. Ideally they should be written as much as possible in terms of business functions and should avoid equipment descriptions.

For example, instead of saying "must have an 8-inch, double-density disk drive," it is better to say "must be able to store one month's transactions on line for processing." Not only are these "functional" specifications easier for a business manager to formulate and understand, but they also emphasize the end results and allow flexibility in how the system accomplishes them.

To write specifications you may want to get help from someone with computer expertise, either a consultant or a knowledgeable acquaintance. Knowledge of the capabilities and limitations of computer systems will help in creating realistic specifications. Because you are most familiar with your business, however, avoid the temptation to let a consultant do all the work. Stay actively involved to ensure that all your needs are expressed.

After some specifications have been drawn up, you can look back at your objectives and decide which of your specifications are mandatory and which are desirable. Mandatory requirements are those without which the system simply does not meet your needs. These are important and so should be identified. Desirable features are those that would be nice, but without which you could live if you had to. Identifying desirable and mandatory features allows you to see where you can make compromises and trade-offs without sacrificing the usefulness of the system.

### Step 7—shop around

Most first-time computer shoppers buy from the first vendor they visit. While there was a time when your options were limited by the small amount of hardware and software being offered for small business applications, that day is gone. Today the market is highly competitive, and the choices available in hardware and software make shopping around a must.

Computer stores are appearing in all major cities and many small towns. These stores provide an excellent opportunity for buyers to see many of the systems on the market. Do not hesitate to ask to try out a system. You may even want to take along some of your employees to ask pertinent questions and become familiar with the systems.

### Step 8—evaluate the systems and the vendors

Evaluating the systems involves weighing the costs against the benefits projected in Step 4. Because systems vary in capabilities and costs, this is often more difficult than it sounds. A handy tool to have is a checklist of important features to help you make a direct comparison between systems. The sidebar on page 47 contains some questions to include in such a checklist.

At this point, I must discuss a very important point to keep in mind when evaluating systems. A computer system actually consists of two parts: the hardware and the software. The software is the set of programs that performs the job and, therefore, is the primary concern in choosing a system. Hardware is important only in how it executes the software.

Some software packages are written to be run on only one model of computer. In this case, the choice of a specific piece of software would dictate what hardware you will purchase. Often the software has versions written to run on a number of different machines. While one computer may run the program quickly and efficiently, however, another system may be slower and less efficient with the same program. In this case, the goal is to find the optimum combination of hardware and software.

Evaluating the systems themselves is only part of your job. An evaluation of the vendor is an important part of choosing a system. To get an idea of how the vendor rates on customer support, ask the salesperson or sales manager to give you the names of some of their previous customers. A short chat with customers who are using that vendor's systems can reveal any problems they may

have getting repairs or other service. Here are a few items you should check:

- How long before the system can be delivered and running?
- What kind of training, if any, is available?
- How fast is service?
- Will the vendor offer assistance in setting up the system?

The evaluation of the system and vendors may be another area where you will want the recommendations of a consultant or someone with some expertise. Whether you are alone or with an expert, insist that the salesperson talk in your terms. Do not let the experts get carried away with computerese and leave you in the background. Ask questions, and keep asking until you understand the answers.

### Step 9—choose your system

Eventually you will have to make your choice. This is the hardest step. Many buyers get themselves caught in the procrastination trap. "If I wait a little longer, the price will drop," or "a newer, better model will be coming out." Although this is very often true, it is also true that you could postpone your purchase forever waiting for that new system or lower price.

If you have done the previous eight steps well, you should be able to have confidence that the system you choose

will do your job. And after all, that's the name of the game.

### Last thoughts

These nine steps outline a very general methodology that virtually anyone can adopt when buying a computer system. In addition to these steps, four other rules are important to a satisfactory computer acquisition.

- Rule 1—write things down

Writing down your thoughts and actions in journal style is a handy habit to develop. Obviously, you will be writing down your work load analysis, specifications and checklists. You should also write down decisions you make, your reasons for making those decisions, and observations you have on your business and on various systems you evaluate.

Documenting your activities serves three purposes: it helps you remember what has happened and keep things in perspective; it allows you to backtrack and make changes along the way; and it keeps a record of lessons learned for next time (or for writing a magazine article).

- Rule 2—plan ahead

A timetable is a useful item to keep events on track. If you have a slow season around the holidays, for instance, you may want to plan the installation and conversion for this period to minimize the disruption of business. Plan the time you will allow yourself for the analy-

ses, specifications, evaluations, and so on, so that you can anticipate when the system will be purchased.

Also decide which business functions will be put on the system first and which ones can wait. Plan as far ahead as you can, but remember that surprises will occur unexpectedly. Very often a manager finds that after a computer is in, new applications crop up that s/he did not consider.

- Rule 3—do not be afraid to appear ignorant

We are all ignorant about something. If you are ignorant about computers, do not let the "experts" take advantage of you. Ask questions, and use this as your opportunity to learn. The difference between ignorance and stupidity is that the stupid person does not ask questions.

- Rule 4—do not put blind trust in methodologies

Everyone looks for recipes on how to make decisions. Such recipes do not exist. A good methodology is general and flexible, not a recipe to which you must adhere. Always remember, when you are faced with a new situation, common sense is one of your best tools. □

---

*The author is a computer systems analyst for the US Navy. She is currently teaching computer system acquisition to mid and senior-level government executives. For more information, write to her c/o Desktop Computing.*

---



# How to Choose a Portable

*Factors to consider before you take the plunge*

by Stanley J. Wszola

Just a year and a half ago the Osborne 1 portable microcomputer had no competitors. Today at least 50 portables fight for a share of the market, and new machines are announced almost daily.

There's definitely something going on out there, and it bodes well for the consumer. Manufacturers, trying to outdo the competition, are offering better, more powerful, and more attractive portable computers. It's the free market at its best. The only problem with this abundance of portables is that buyers often don't know where to begin. To that end, we'll start with an explanation of what a portable computer is and then explore its various components. While that won't tell you which portable to buy, it will provide some signposts to help you make an informed choice.

The sudden appearance of portable computers results from a convergence of technologies. Many features found on portable computers have been used and refined on products such as digital watches and pocket calculators. In addition, the products of the years of research and development that went into creating today's desktop microcomputer have finally come together in the portable computer. What we have is reliable hardware and proven software in a machine that can be shuttled easily from office to home or wherever. Portable computer users include business people who like the flexibility of working at home or on the road, scientists and engineers who take their portables into the field for on-site computer applications, and people who simply like to take their computing power with them.

## What Is a Portable?

A portable computer is, of course, a computer first and foremost. It must have a central processing unit, memory, a method for data entry, a

device for or method of displaying data output, and usually a means of storing data.

A portable computer must be easy to carry from place to place. Don't confuse "portable" with "transportable." Any computer can be transportable if you have a big enough truck. For the purposes of this article, a portable computer is one that can be carried by one person—but not necessarily easily carried. Currently, portable computers can be divided into three rough categories:

**Pocket computers:** These can be characterized as pocket-size, battery-powered, lightweight computers with a 1-line display, limited memory (0.5 to 10K bytes), and usually BASIC in ROM (read-only memory). Most use cassette tape for data storage. The keyboards on these computers are not suitable for touch-typing, and the 1-line display is adequate only for simple programming. Many of these computers can accept accessories (i.e., printers, serial- and parallel-port interfaces, and modems) to increase their usefulness.

**Briefcase computers:** As the name implies, these computers are small enough to be placed in a briefcase. They usually have a 4- to 8-line display, a full-size keyboard, provision for increasing internal memory, serial and/or parallel ports, and AC or battery power. Most briefcase computers feature BASIC in ROM, and some include applications programs for word processing, telecommunications, and appointment scheduling. Data storage can involve micro- or full-size cassette tapes, auxiliary floppy-disk drives, or bubble and CMOS (complementary metal-oxide semiconductor) memory cartridges. Most have full-size keyboards that are suitable for touch-typing. Their light weight (5 to 10 pounds) and small size let you use them almost anywhere. One

example of a briefcase computer is the Radio Shack Model 100.

**Transportable computers:** These are the heavyweights of the portable-computer field in terms of size, weight, and capabilities. I've used the term transportable because some so-called portable computers are nothing more than a boxed desktop computer with a handle on top. Most are the size of a small suitcase, weigh 15 to 40 pounds, and usually have a CRT (cathode-ray tube) display with one or more floppy-disk drives. Most

---

**Any computer can be transportable if you have a big enough truck.**

---

use CP/M-80 or CP/M-86 and MS-DOS operating systems. These computers can do anything the desktop models can do, but their portability is limited by the necessity for AC power or a heavy battery pack. The Osborne Executive is a transportable computer.

## Power Sources

The growing use of low-power CMOS RAM (random-access read/write memory) chips and CMOS microprocessor chips, such as the 80C85 used in the Radio Shack Model 100, has decreased dependency on AC power sources. Battery-powered portables can be used almost anywhere. But batteries can be a curse as well as a blessing; they add overall weight to the package and always run out just when you need them most.

Most portable computers can run from 2 to 10 hours before they need a recharge. Battery life depends on the power requirements of the computer, the length of time it has been



operating, and the rating of the battery. Some portables have low-voltage indicators to alert you when the batteries run low. The transportable models are more power hungry than the smaller portables. The CRT and the disk drives in the transportables require a lot of energy.

Some briefcase computers use CMOS memory chips and an auxiliary nickel-cadmium battery to preserve data in memory if the main batteries fail. For example, the nickel-cadmium batteries in the Model 100 can maintain data for 8 to 30 days, depending on how much memory the computer has. This gives you an extra margin of safety if you are unable to replace or recharge the main batteries right away.

Many transportable computers have auxiliary battery packs as options. Of course, you still face the problem of carrying the batteries as well as the computer. Finally, some manufacturers offer an optional auto adapter, which lets you plug your computer into your car's cigarette lighter. They recommend using the computer with the engine off to eliminate lost data due to voltage spikes and surges. That's just as well; you don't want to be downloading a program and downshifting at the same time.

## Video Displays

The new portables use one of three types of displays: CRT, LCD (liquid-crystal display), or ELD (electroluminescent displays). CRTs have been around for a long time and are a proven medium. LCDs, although limited in their ability to display graphics, are lightweight and don't consume too much power. The newer ELDs have the same display capabilities as CRTs with an extra advantage—their flat shape makes them ideal for use in portables. I'll explain each in detail.

The most commonly used display for portable computers is the reliable, flexible, and easy-to-use CRT. Most users are already familiar with it. Its primary disadvantages are a bulky shape and high power consumption. The CRT itself, a large, fragile glass tube, must be protected from harsh

environments and airport baggage handlers.

But the advantages of the CRT outweigh the disadvantages. First, it is a luminescent display—it produces light. Therefore, it can be used under poor lighting conditions. Second, it is extremely flexible. Given a monitor with sufficient resolution, you can display any type of image upon it, including color, such as with the Commodore Executive 64. Finally, there's enough software available to take advantage of that flexibility.

The second most popular form of display is the small, lightweight LCD, which usually requires little power and is relatively immune to damage. One disadvantage is that an LCD's response time is slower than that of a CRT display in terms of speed required to write and erase a character on the display. Additionally, the LCD bit-mapped graphics are at best crude because the individual pixels (picture elements) aren't small enough to give sharp definition. And at temperatures below freezing, the LCDs may slow down even more or stop altogether.

The Sharp PC-5000 has the largest LCD currently available on a portable computer, 8 lines by 80 characters

Whether such a display is large enough for effective work is a matter of personal taste. Portable computers with a 1-line display are minimally usable. The HP-75 has a 1-line by 32-character display. The Epson HX-20 has 4 lines by 20 characters. The Radio Shack Model 100 has an 8-line by 40-character display. You can work with all of these displays, but they are only a fraction of the size of a standard CRT display of 80 characters by 24 lines. You should carefully consider the display size in terms of your particular application and choose the portable that best fits your needs. Word processing on a 4-line display is awkward at best.

Finally, the new ELD and gas-plasma display technologies provide still another choice. ELDs use a chemical coating and a wire grid placed between two glass plates. The chemical coating emits light when an AC voltage is applied to the wires.

Alphanumeric characters can be formed by applying the voltage to the correct sequence of wires. The gas-plasma display is similar to the ELD except that a gas fills the space between the two plates. The Grid Compass computer has an ELD screen.

ELDs combine the advantages of the CRT and the LCD. They can display a full 80 characters by 24 lines, offer good bit-mapped graphics resolution, and their flat shape makes them ideal for portable applications. The only disadvantage is that both their price and power consumption exceed the level of other displays. For now, field testing will have to determine whether the electroluminescent and gas-plasma displays are economical and reliable enough to replace the CRT display for portable computers.

## Data Storage

Developments in data-storage technology have enabled portable computer users to take their data along with them. The newer half-height 5¼-inch and 3½-inch floppy-disk drives have as much storage capacity as the older 8-inch drives. Hard disks are also becoming portable. For example, the Kaypro-10 has a built-in 10-megabyte hard-disk drive. Some portables feature bubble-memory cartridges for convenient long-term data storage.

Memory is the working medium of any computer, and portables are no exception. Yet portables, because they incorporate the latest technology, offer more memory options than standard desktop computers. You can have a portable with CMOS RAM, bubble-memory cartridges, mini- or micro-floppy-disk drives, or hard disks. Each option has its own particular advantages and disadvantages.

CMOS memory is widely used in briefcase computers because of its low power consumption. The recent improvement in chip-manufacturing technology has lowered the price and increased the performance of these memory devices. CMOS chips are still slower in operation than corresponding TTL (transistor-transistor logic) memory devices, but their



speed is improving. In actual use the speed of a CMOS memory chip does not adversely affect the operation of a portable computer.

Bubble-memory cartridges have been around for a while but haven't been widely used because of their high price. But, like CMOS memory, their price is dropping and their use is increasing, especially for the briefcase computers. Bubble-memory cartridges offer several advantages over other storage media such as floppy disks. They operate like a floppy-disk drive but much faster; they have no moving parts and no disk-drive head to move from track to track. Data is stored in the cartridge as a pattern of magnetic bubbles, and when the cartridge is removed or power fails, the stored data is retained. The cartridges do not require an auxiliary battery to retain data. They require very little power to operate and are much more rugged than conventional floppy disks.

Floppy disks are still very much the medium of choice for people who work with portable computers. They are widely used, dependable, and have a broad base of available software. With the introduction of half-height and microfloppy-disk drives, floppy disks remain the primary data-storage medium. The disadvantages of floppy disks include occasional incompatible recording formats for 5¼-inch disks and the confusing differences between the various standards for the microfloppy-disk drives.

Before buying a portable or transportable computer, find out if it can read and write to disks from other computers. The Kaypro II

for example, can read and write to disks created with a Xerox 820-II. And the Kaypro Users Group has software available that will enable the Kaypro II to read other disk formats.

Rather than carry a lot of floppy disks, you can opt for a portable with a built-in hard-disk drive. Portables such as the Kaypro-10

with its 10-megabyte hard disk and the Starlite HD20 with its 20-megabyte hard disk can serve users with very large data-storage needs. Both have a staggering

amount of storage for a portable computer system and can handle almost any application.

Hard-disk-drive manufacturers carefully studied the typical environment of a portable computer and have developed drives that have special shock mountings and head-positioning controls to withstand shock and vibration. For example, both the Kaypro-10 and the Starlite HD20 have utility programs to position the read/write head in a "safety zone" on the disk that is isolated from the data tracks; if a head crash occurs while the computer is in transit, you will probably be able to recover your data. In addition, the read/write heads have been redesigned to be lighter and less prone to shock.

Hard-disk drives are an expensive option, but their price is dropping. However, they are heavier than floppy-disk drives and consume more power because the disk is constantly spinning while it's on. Another potential problem is the possibility of data loss due to a head crash. This occurrence is more serious with a hard disk loaded with great quantities of data than for a set of floppy disks.

For most of the transportable computers that use the Z80 microprocessor, the de facto operating system is CP/M. Compatibility is reasonably assured regardless of the type of computer, magnetic media, or display used. Practically every major software application package is available in a CP/M format. By using a standard operating system, you have access to a tremendous number of programs, programming utilities, and languages.

But the issue of compatibility becomes much more complicated when computer manufacturers try to make their computer emulate the functions of another machine, as is the case with the many IBM Personal Computer work-alikes. This continues to be a confusing issue because three levels of compatibility have emerged.

Incompatible disk formats or different-size media characterize the first level. For example, the DOT com-

puter uses an 8088 microprocessor and runs MS-DOS, but it uses the Sony 3½-inch floppy-disk drives, which are not compatible with the standard 5¼-inch drives used on the IBM. As a result, you would have some work to do to transfer programs from the IBM to the DOT computer.

The second level is data compatibility. Most "IBM-compatible" computers fall into this category. With a data-compatible portable, you can transfer data created on an IBM disk to a portable computer. But you cannot transfer the program used to create those data files. For example, you can create a data file with an electronic spreadsheet program on the IBM and use that data on a compatible portable as long as you have the same version of the spreadsheet program for the portable.

The last level of compatibility includes computers that are "almost a clone." These systems, such as the Columbia VP offer the same graphics capabilities and keyboard as the IBM and use the same software. They differ from the IBM PC only with respect to the information stored in ROM. The PC has a copyright notice in its ROM. Some programs such as Visicalc only work correctly after locating the copyright notice in ROM. Most software will work correctly, but in some cases you need to get a version of the program specifically tailored to your computer. Before choosing a portable, find the software you want, and then make sure it runs on the computer you like.

## Software

Bundled software is a great value. It lets you get the computer up and running as soon as you take it home. Manufacturers usually offer word-processing, electronic spreadsheet, database-manager, and perhaps communications packages. Some portable computers have as much as \$2500 worth of software bundled with the hardware. Bundled software also enables you to try the various programs before you buy a complete system.

But don't let the lure of bundled software sway your decision on which portable computer to buy. You

may not like a particular software package that is included with the portable computer you choose. Selecting software is sometimes a very subjective decision. The software and hardware must combine to meet your needs. If they don't do what you need, you shouldn't buy them.

### Defining the Workplace

When considering the purchase of

a portable computer, ask yourself one more question, "Where do I need a computer most?" Do you really need a heavy-duty CP/M system that can be transferred from the office to home? Or do you need a computer that can go on the road for data collection in the field? You may be the ultimate computer junkie who likes to work in pajamas in bed at 2 o'clock in the morning. Your ideal working environment is critical in your choice

of a computer.

### Summary

Choosing a portable computer isn't easy. The number of portables and the variety of available features make the choice a tough one. But with the right background and some in-depth research, you'll be able to find one that suits your needs. ■

---

*Stanley J. Wszola is a BYTE technical editor.*

---

*(EDITOR'S NOTE: Excerpt from original article - directory of portable computers extracted).*



# Multi-user Systems Offer Substantial Savings

Efficiency goes up as costs go down.

**B**uy eight computers for the price of three? If that is an offer that interests you, perhaps you should be considering a multi-user desktop computer for your business. These systems can present a unique savings opportunity for you and still provide the flexibility for expansion tomorrow—if you understand their limitations.

As more and more multi-user desktop computers are announced by manufacturers on an almost daily basis, the potential buyer of these systems will find him or herself confronted with a set of little-known problems and issues unique to this type of computer. The customer needs to understand and be familiar with these is-

sues in order to judge whether this investment is right for him or her.

There are many kinds of multi-user systems, but they can be reduced to two basic forms: single processor and multiprocessor. Each of these has its own advantages and disadvantages relating to cost, performance and the number of users that system will support. The choice that a particular business might make relates directly to its own required mix of these factors. In order to get a better idea of which system might be right for your business, let's take a brief look at each.

## Single processor

The single-processor-based system, as

the name might imply, is based on one central processing unit, or CPU. This type of system allows more than one user to run programs by allocating a portion of its memory to each user and servicing each user when the CPU has time available. Thus, even the microprocessor and the system memory in this configuration can be regarded as shared resources.

Cost effective as this is, there is a major disadvantage. Because many users must share the CPU, response time (that is, the length of time between a user request and the computer response) can often be longer than desired. The limited speed of today's popular eight-bit microprocessors, such as the Z-80A, makes it generally unrealistic to expect these systems to support more than three or four users at a time. At the same time, these are usually the least expensive of the multi-user computers, and, on a per-unit basis, are usually less expensive per user than single-user and multiprocessor systems.

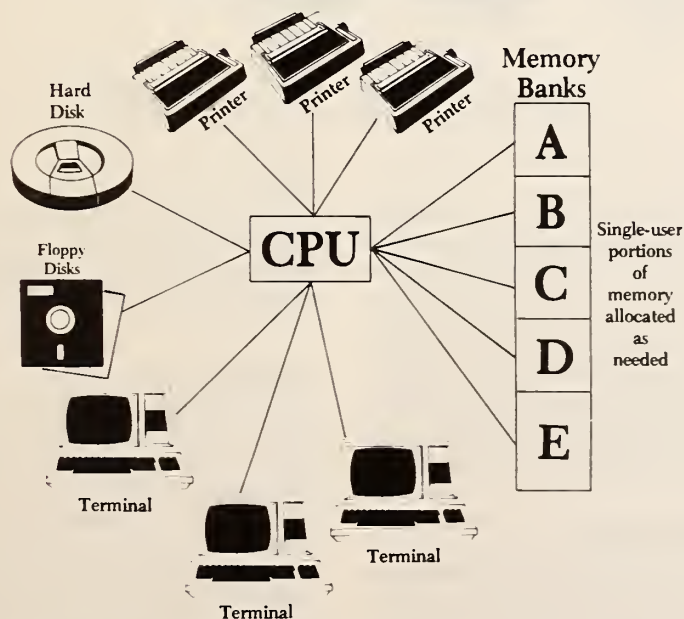
Finally, as newer systems sport faster and more powerful microprocessors, these multi-user, single-processor systems will be able to support more users and give better performance than the eight-bit systems they are replacing.

## Multiprocessor

Multiprocessor systems are generally more powerful than single-processor systems in that they provide more than one CPU per system. Typically, each user is given one microprocessor and a full complement of memory to service his or her particular processing needs. With one exception, this allows the user to run completely independent from other users.

The exception concerns disk access. Since these systems share disk storage units, they must wait for other users who might be getting data from the disk. Multi-user systems in general have Winchester hard-disk systems because their capacity

### Single Processor Architecture



One CPU services all resource allocations, input/output and processing requirements.

and speed are generally a generation more advanced than floppy disks. The hard disk, then, can more than handle the requirements made on it by the multi-user environment, and the user is, practically speaking, independent from the other users.

### Efficiency trade-offs

There is, of course, a price for this extra performance. Since every user owns, so to speak, his or her own CPU and memory, these items are not shared, and the duplication of them adds extra cost to the system. The result of this duplication, however, allows the system to support more users and give a faster response time.

Finally, there are variations between single and multiprocessors that do not function independently, but assist the main CPU in increasing speed and reducing response time. In order to increase the physical number of users the system might support, some multiprocessor systems physically separate each set of CPU and memory from the others. In such cases, each system resides in the terminal, and cable connections are used to bring stations together at the common hard disk. Since the cables have relatively slow data transfer rates, this approach can slow down the speed of the system, but it provides flexibility in the number of users the system can support.

Perhaps the most straightforward way of seeing the financial benefits of multi-user desktop computers is in their ability to share resources. Let us take, for example, a business that requires five user stations to meet its particular needs. If that business bought five single-station personal or business computers, it would also be likely to need a printer and a floppy or hard-disk drive for each station. These peripherals alone could easily cost as much as \$15,000.

A multi-user system, however, has the ability to share these expensive peripheral resources by controlling them from a common, centralized unit and thereby allow the five users in our example all to have common access to one printer and all to store their individual data and program files on one disk-storage unit. Therefore, the cost per user of these systems can be substantially reduced from the single-user systems.

### Software issue

A similar, but less well-defined situation, exists with software. Most software companies require that the end-user buy one copy of the particular software package for each physical machine that the

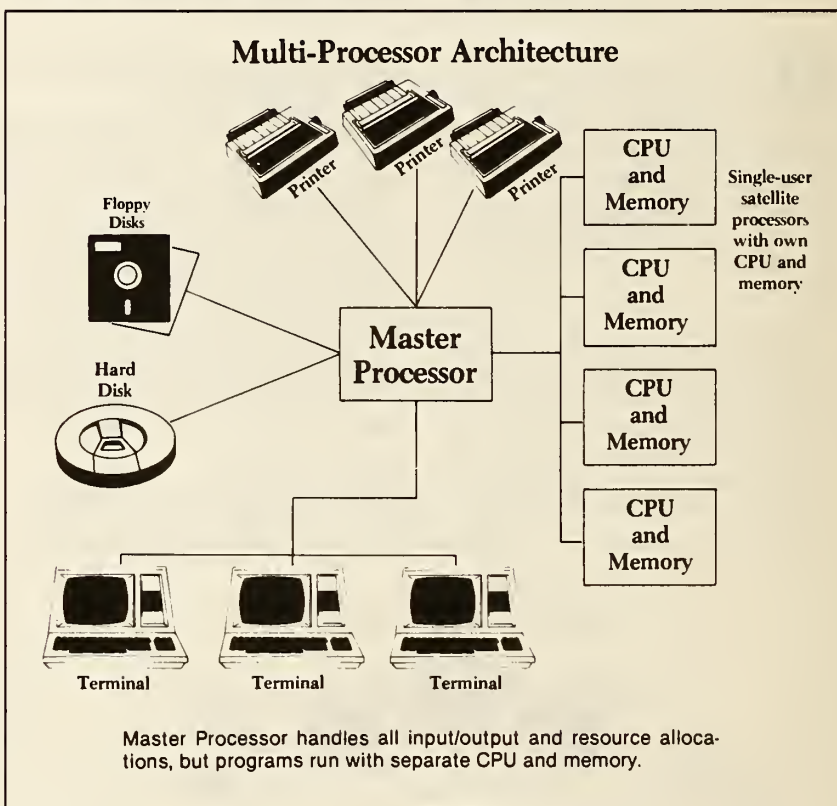
software is to run on. Since a multi-user system is one physical machine, there generally is no need to buy the multiple copies of software that would be necessary on single-station desktop computers.

The growing popularity of multi-user systems, however, has been of increasing concern to some software vendors. They see lost revenues growing as more and more business managers choose to take advantage of multi-user cost savings.

For example, MicroPro International, the vendor of Wordstar as well as other popular software packages, announced in May 1982 that owners of multi-user sys-

in general. These problems arise out of the same factors that make the multi-user environment desirable in the first place: the ability to have more than one individual use common resources at the same time. The issues we will consider include the following:

- Data integrity. What happens when two people try to update the same data at the same time?
- Proper protection of your data.
- Security. How do you control access to sensitive data files—for example, payroll files—and other powerful capabilities of the computer?



tems would be required to buy, on a sliding scale, multiple licenses of the product dependent on the number of users that the system could support. It remains to be seen whether this becomes an industry trend or whether user and dealer resistance and poor enforcement will make this an isolated case. Nevertheless, shared resources remain one of the better reasons for considering a multi-user desktop computer.

### Multi-user issues

Now that we have a basic understanding of the differences between the various types of systems and how they can save the buyer money, we can address the issues that are unique to multi-user systems

We will discuss these issues with the intent to understand what the business professional needs to know in order to make an educated decision for his or her particular business needs.

### Data integrity

The term data integrity refers to how we assure that the information in our data files is what we believe it to be. For example, an airline data entry operator, inquiring as to seat availability for a particular flight, receives a response from a computer that there is one seat left on the flight. In just the instant after the information was delivered to that operator, however, another operator working with the same computer sells that last seat and



## Selection

enters it into the computer. Our first operator now believes that there is a seat available on the flight, when it really no longer exists.

What happens now if our unsuspecting first operator tries to sell that now nonexistent seat? Unless the system knows specifically how to deal with the situation, the results will be unpredictable. We do not know for certain what has happened to the data file, and therefore the file no longer has integrity.

As you can see, a single-user computer will never have this problem because there will never be more than one operator using the system at any given time. But the prospective business professional considering a multi-user system must make sure that the above type of problem never occurs in his or her accounts receivable or inventory system.

The most simple and straightforward solution is to assure that, in the environment where the computer will be used, each user station is assigned a specific function that only it will perform. For example, bookkeeping functions will take place only at the accountant's user station, and inventory updates will only be allowed from the warehouse user station. In this way, the issue of simultaneous updates will never arise.

This is, however, not always practical. Perhaps it is desirable to run a single program in a multi-user environment where more than one user will be updating the same file (for example, a sales order entry system). In this case, the computer itself must safeguard the integrity of the files.

Some vendors of multi-user systems have supplied their computer's operating system (the computer program that controls the computer's resources) with a "record-locking" capability. Most simply stated, record locking means that, when data (or records) are being updated, no other user can slip in and change the data during the update. This prevents the problem we have been discussing and gives the data the integrity that we have been searching for.

### Still not sufficient

Unfortunately, after saying these things, there remains one last problem. The mere presence of the record-locking capability in an operating system does not mean that the application program actually uses that capability.

Similar to a parachute, the record-locking feature gives little benefit until it is actually used by the application program. If the program is not specifically designed to use the operating system's particular record-locking capability, this feature gives

no protection. Thus, when making a software decision for multi-user systems where record locking is an issue, it is necessary for the prospective buyer to make sure that the application programs as well as the operating system offer and implement the record-locking feature.

Does this mean that all your software must implement record locking? No. For example, word processing usually does not require it because it is unlikely that there would be a need for having two people edit the same letter simultaneously. When there are data files critical to your business, however, and more than one user will have access to them, you must make the decision as to how you will deal

---

**The multi-user system is part of the logical development of desktop computer technology. As the microprocessor continues to become more powerful, we will see more and more computers capable of supporting multiple users simultaneously.**

---

with the integrity problem. Popular accounting packages that business professionals might be familiar with on single-user systems could require modification or be entirely unacceptable because of their inability to work reliably in a multi-user environment.

Proper backup of company data is critical to all computer systems, but is especially important in a multi-user environment. More than one user is now depending on the system. You might have more data on the computer than a single-user system would have. Thus it is necessary to make sure that your multi-user system has an adequate backup mechanism other than a floppy disk for a backup.

Why not a floppy-disk backup? Let's step back briefly. The system you choose will most likely use a hard disk as its storage medium. Hard disks can hold much larger amounts of data and are also much faster. This benefits the user in two ways. First, users avoid having to run back and forth switching relatively low-capacity floppy disks in and out of the machine. Also, hard disks are much faster than floppy disks, and, with the possibility of

simultaneous requests for data, floppy disks generally give too slow a response to be considered effective.

Keeping these facts in mind, it can take up to 40 floppy disks to back up a medium volume (20 megabyte or 20 million characters of memory) hard disk. This method can take up to several hours, be difficult to manage properly and, for today's business professional, is impractical.

Cartridge-tape-backup mechanisms, on the other hand, cost relatively less (approximately \$2,000 to \$4,000), are reliable and can back up in 15 minutes the same hard disk that took 40 floppy disks and two hours. For this reason, a backup method similar to cartridge-tape backup should be written in as a part of the minimum cost for the system. The possibility of vandalism, sabotage or mechanical failure makes this extra precaution a good and necessary investment.

### Security considerations

The last issue we will consider here is one that is too often overlooked when purchasing a multi-user desktop computer—the issue of software security. The problem of security is simple: how to give users of the computer the power they need to perform the specific functions they are responsible for, without allowing them access to, capabilities and sensitive data files that they do not need to have.

Some of the capabilities we are concerned with here include the ability to do the following:

- Delete files from the disk unit.
- Modify files, such as payroll or payables.
- Rename files.

As we have seen, multi-user systems have the cost-saving advantage of sharing resources. But now we see that we must have some way of protecting and controlling the confidentiality of key data files, as well as prevent others from unknowingly or maliciously invoking powerful operating system commands that will be harmful to the integrity of the system in general.

One way for a business professional to protect the security of the system is to purchase application programs that have a security feature built into them. In this type of arrangement, the user must type in a password to the program after invoking it and is not allowed access to the program if s/he cannot supply the correct code.

This solution, however, is not ideal. First, not all applications have password support. Second, it is often relatively easy for a person with some programming knowledge to outsmart this kind of device and gain entrance to the program with-



## Selection

out knowing the password. Thus, the password protection becomes little more than a temporary annoyance for the individual who is really determined to get access to the information. Finally, password protection of application programs does not address the critical problem of restricting the availability of powerful operating system commands to the unqualified user. Therefore, a better solution

is to implement the password protection on the operating-system level, instead of the application level.

Operating-system-level protection refuses the user access to the computer system in general until s/he enters his or her personal password. This password is given to the user by the person responsible for the computer installation. This person determines what capabilities each user of the

system will need and what programs the user should be able to use. The password tells the operating system what kinds of programs the user should be allowed to use and the kinds of system commands that the particular individual may use.

Thus, when an individual logs on to the computer, the system automatically knows the limitations that it will impose on the particular user. The data entry op-

## Ten Steps for Choosing a Multi-user Desktop Computer

1. Determine how many user stations you need now. If you need more than eight, multi-user desktop computers are probably not yet ready for you.

2. Figure how much hard-disk capacity you need. Although this varies widely between applications, a good rule of thumb is to have five megabytes (5 million characters) per user station.

3. Determine the dollars that you are willing to spend. If your figure is less than \$2,500 per station (including tape backup and printer, but not including application software), go back to step one and revise downward or realize that your budget is not yet ready for a multi-user desktop computer. If your number is between \$3,000 and \$4,000 per user station, you will have a wide variety of choices.

4. Determine your processing power needs. Are your applications mathematically intensive? Will you run more than three users simultaneously now or in the near future? Is fast response time a critical requirement? If so, then you probably need a multi-processor or at least a 16-bit single-processor system.

5. Prepare yourself to do business with a single vendor. Because of the special integrity and security issues involved with multi-user systems, find a vendor who is sensitive to these issues and is prepared to provide software that meets your unique requirements, as well as installation and training. Although this may cost a bit more, the comfort of knowing that you have a single source for help is important.

6. Determine which applications will have more than one station accessing common files simultaneously. Is it practical to restrict this activity to a single-user station? If not, the software that you purchase should implement some type of record-locking protection.

7. Determine your security requirements. Will there be data files that certain individuals in the organization should not have access to? If so, the operating system or the application software that you buy should have a demonstrable security feature.

8. Make your vendor demonstrate the multi-user environment you are interested in. Too often, computers are purchased without the buyer seeing the computer in question running as a multi-user system. If you are considering a five-user system, and the vendor can only show a single-user configuration, how do you know that the system will meet your performance requirements?

9. Be sure the system provides a backup. Tape backup is probably best here, but the system should offer some backup system besides floppy disk.

10. Buy a maintenance contract. This is true for all computers, but is especially important here. By purchasing a multi-user desktop computer, you are by definition trying to increase more than one person's productivity. A reasonable rate is between one and two percent per month of the hardware's retail price for 24-hour service. Be glad to pay it in order to keep your people up and running.

**P**roper backup of company data is critical to all computer systems, but is especially important in a multi-user environment.

erator will be allowed access to the data entry program only and not be allowed to delete files, thus ensuring that the system is secure.

While no system is foolproof, this method seems to be better than the previous one discussed. It is much more difficult to break into, and the user need know only one password, as opposed to remembering a password for each program. Unfortunately, not all multi-user desktop computers offer this type of sophisticated operating system security feature. Prospective buyers need to measure their particular security needs in light of the systems that they are considering.

### Summary

The multi-user system is part of the logical development of desktop computer technology. As the microprocessor continues to become more powerful, we will see more and more computers capable of supporting multiple users simultaneously. Further, multi-user desktop computers can offer substantial savings today as long as the buyer understands the issues that are unique to these types of systems. While no one system performs all the functions discussed here equally well, the multi-user desktop computer is an important option for those considering a computer solution to the challenges of doing business today. □

*Ken Pedersen has a philosophy degree and is actively interested in electronic and computer-generated music. You may address any comments to Mr. Pedersen in care of Desktop Computing.*

## 5. HARDWARE

# Bit By Bit

*Much excitement has been created by the development of the 16-bit computer. Its greater memory, increased speed and multiplied functions have outstripped the capabilities of the more conventional 8-bit machines. There may be important implications here for users of small computers. Many such users, however, are quite in the dark about just what all this talk of bits and buses is about. Read on and Desktop will make you, if not an expert, at least an informed layperson on this "bit" of important technology.*

**M**y eighth-grade mathematics teacher explained the Theory of Permutations and Combinations (a fancy way of saying "possibilities") in the following manner: suppose you had a coin in front of you. There would be only two ways to display the coin, heads or tails. If you had two coins, there would be two possibilities for each coin and a total of

that computers use microscopic electrical switches with ON and OFF (which we represent as 1 and 0), rather than coins with heads and tails. Each 0 or 1 is a bit, each 8-bit grouping is a byte, and each byte represents either a piece of data or the address of the location of that data in the computer's memory. Data might include a letter of the alphabet, a number or

The location of a piece of data—as opposed to the actual data—travels to and from memory via a pathway known as the address bus. Because an address bus that is 8-bits wide allows only 256 different locations for data storage in the memory, most 8-bit computers, by convention, have address buses that are two bytes wide. The number of possible loca-

four possible arrangements: heads-heads, heads-tails, tails-tails and tails-heads. Three coins would have eight arrangements, four coins would have 16, and so on. For each coin that you added there would be twice as many arrangements as before.

This might not have seemed exciting to my classmates, but to those of us reared on a diet of secret codes in comic books, the implications were obvious. With very few elements, one could devise a code with an infinite number of possible arrangements, each one to stand for a particular letter or word. For example, with just five two-sided coins, one could have 32 possible sequences, enough for all of the letters of the alphabet, plus punctuation marks. And with eight coins, one would have 256 (two to the eighth power) distinct sequences.

There you have it—the basic theory behind an 8-bit desktop computer, except

a punctuation mark, according to the American Standard Code for Information Interchange (ASCII). For example, in ASCII, the 8-bit code for the letter A is 01000001.

An 8-bit computer then, has 256 possible character sequences—which may seem like an excessive number until you recall that there are both upper and lowercase letters, numbers and punctuation marks that need to be represented. These ASCII codes account for half of the sequences, which are standard on all computers. The remainder of the codes are designated by the individual desktop computer manufacturers to represent functions available through special function keys, and to organize the way in which the computer will enter and retrieve information—the Basic Input/Output System (BIOS). This kind of information travels to the computer's memory via an 8-bit pathway known as the data bus.

tions in memory is thus  $256 \times 256$  or 65,536. One K of memory equals 1,024 bytes, and 65,536 bytes equals 64K, which is the maximum memory for most 8-bit computers. In concrete terms, this is equivalent to 32 double-spaced typewritten pages of material.

The width of address buses for 16-bit computers varies, but generally, the upper limit is 24 bits—one 8-bit and one 16-bit sequence. The number of different pieces of information that can be addressed with this system is two to the 24th power or a little more than 16 million bytes of information, the equivalent of 8,000 pages of information.

## Faster than a speeding 8-bit

Not only do 16-bit computers store more information than 8-bit machines, they can process it faster. This results from the fact that in a 16-bit computer, the registers—the devices that hold infor-



mation while it is being processed—are twice as long as those in 8-bit machines. This is akin to having two accountants instead of one—they can get more work done.

A number of other computer functions are improved through the use of 16-bit technology. They include:

1. *The use of complex application packages.* The extra speed and memory of 16-bit computers have made possible the development and use of integrated software packages with a number of functions on a single disk, such as Lotus Development Corporation's 1-2-3.

2. *Friendlier use.* It takes a lot of instructions to the machine to make a computer truly "user-friendly" and 16-bit machines have the room to do this.

3. *Improved graphics.* Computers that can address a greater number of locations can support higher-resolution graphics.

4. *Faster computational speed.* "Number crunching," or mathematically manipulating numbers, is made faster and more efficient through the use of 16-bit machines.

5. *Multitasking options.* The additional memory and speed of 16-bit computers can allow them to do two things at once, such as editing one file while another file is being fed to a printer. This, plus faster computational speed, gives 16-bit computers a high throughput, or level of productivity.

6. *Multi-user options.* The increased performance of 16-bit machines makes the addition of satellite terminals easier and gives them more power.

### Is 8-bit dead?

Given the impressive abilities of 16-bit computers, one might wonder how much of a future 8-bit computers have. A recent issue of *InfoWorld* queried industry leaders

and found that, in their opinion, 8-bit computers were far from dead. The reasons given by most were the high cost of 16-bit machines, the lack of software available for them, and the fact that the 64K of memory available from 8-bit computers is probably sufficient for most users at present.

Inevitably, however, the cost of 16-bit machines will come down, more software will become available, and their advantages will attract increasing numbers of buyers. A study released by Advanced Resources Development of Medfield, Massachusetts, predicts that by 1986, 16-bit systems will account for 68 percent of the business-related desktop computer market.

Manufacturers are already gearing up for this market, with a spate of new 16-bit machines. *Desktop Computing's* New Products section for this month alone contains announcements for new machines from Altos, Eagle, Fujitsu, Microcomputer Technology and Televideo. Like IBM PC-compatibility, 16-bit technology appears to be a bandwagon, and more manufacturers are jumping on every day.

### Straddling the fence

A number of manufacturers, such as Fujitsu, are planning ahead for the coming wave of 16-bit software, without writing off 8-bit technology completely. In its newly released Micro 16S, Fujitsu has incorporated both 8-bit and 16-bit microprocessors. This strategy gives users access to the large base of 8-bit software that is already in existence, but will allow them to use 16-bit software as it is developed. Given the present pace of desktop computer technology, the 8-bit microprocessor in this type of machine may someday be an interesting but obsolete evolutionary footnote, much like the human appendix.

For now, there is some controversy over what makes a "true" 16-bit desktop computer. As we mentioned earlier, 8-bit computers have data paths that are 8-bits wide and address paths that are 16-bits wide. A true 16-bit desktop computer has a data path that is 16-bits wide and an address path that is up to 24-bits wide.

Then there are the "sort of" 16-bit computers—depending on your point of view—that are built around microprocessors with 8-bit data paths and address paths of up to 24 bits. The Intel 8088 microprocessor, around which the IBM PC and the majority of its imitators are built, is just such a chip. The end result of this technology is a computer that has a larger memory capacity than 8-bit machines and is much faster, although not as fast as a true 16-bit machine—which may bother some sticklers.

Finally, there are an increasing number of manufacturers developing computers based on 32-bit microprocessor chips or dual 16/32 chips such as the Motorola 68000. Hewlett-Packard and Callan Data Systems recently joined the ranks of companies with 68000-based systems, including Radio Shack, Fortune Systems, Corvus and Charles River Data Systems.

Does anybody really need that much processing power? The answer is "Yes" for some business users and "No" for the average user. After all, almost everybody needs a car, but not everyone needs a station wagon, let alone a Mack truck.

In the 32-bit desktop computer range, the distinction between a "super-micro" (buzzword watchers, take note) and a minicomputer is beginning to be difficult to discern, if not nonexistent. Bit by bit, desktop computers are growing more powerful and—at least in terms of memory—larger. Fortunately, all that power is still being packaged in systems that can sit on a desktop, and are well within the control of the individual user. □

# Purchasing Computer Power

*Use a four-step outline to weigh the cost versus the benefits of memory or storage expansion for a small business.*

Mark Phillips

*"Purchasing Computer Power," Mark Phillips, PC World, May 1983, pages 293-296. Reprinted by permission. Copyright (c) PC World. ALL RIGHTS RESERVED.*

In a world where successful businesses are made or broken by relatively small changes in productivity, the benefits provided by storage and memory expansion devices for the IBM PC can be critical. Many manufacturers have entered the field with hardware and software products ranging in price from under \$100 to several thousand dollars. These products include hard disks for storage expansion, RAM boards and electronic disk emulation software for memory expansion, and software utilities such as print spoolers for increased flexibility.

### The Business Plan

Choosing the best storage and memory expansion devices for a company is difficult enough for those who are knowledgeable about computers. But the choice is more difficult for the typical business person who is unfamiliar with the latest hardware and software developments. He or she must research technical information as well as balance business requirements against budgetary restrictions.

In general, purchasing additional storage for the PC should be approached in the same way as purchasing any large fixed asset; while not as large as some investments, storage devices such as hard disks carry the same kinds of long-term consequences.

Determining the fixed assets a company needs most requires an understanding of a firm's general business plan, methods of operation, predicted growth, and future markets. Surprisingly, many companies, both large and small, neglect to formulate a plan before plunging into business. However, this plan is the key to successfully understanding a company's goals and determining where improvements in productivity are most needed.

### The Decision Process

Once the business plan is established, the next step is to establish a logical procedure for choosing appropriate storage devices. Doing so requires following a specific outline in order

to identify what a business expects to achieve with storage and memory expansion and to determine the most cost-effective purchase. The outline should include the following four steps:

1) *Analyze the features of the various storage and memory expansion devices.* Businesses can choose among a number of products to enhance the productivity of the PC. Roughly, these devices fall into three categories: hard disk drives capable of mass storage, increased RAM capacity and multifunction RAM boards, and special software utilities such as print spoolers that allow the PC to perform several tasks simultaneously (see Table 1). A more detailed discussion of these products will follow later.

2) *Examine the nature of the business.* Does the firm require access to and storage of very large numbers of documents, customer files, or similar data? If so, a hard disk would be a good choice because of its large storage capacity. Does the company use software (such as *WordStar*) that returns frequently to a disk drive for program instructions or additional data? If so, memory expansion with RAM boards and electronic disk emulation software might be the wiser choice.

3) *Consider the office environment and the employees who will use the storage devices.* Are space, noise, or aesthetics critical? Who will operate the PC? Is there a sufficient budget to cover the cost of the device and possible training? Is there more than one PC or are other units a future consideration? Does the business work with copy-protected programs that can't be transferred to a hard disk?

4) *Create and implement a comparative rating system.* This system should evaluate the business requirements determined in the previous two steps against the advantages of each product analyzed in the first step. Budgetary restrictions must also be considered at this point.

### Hardware and Software Options

Researching the alternatives for storage and memory expansion to determine the most cost-effective options for a business requires substantial time and effort. After considering the benefits and disadvantages of each option, discuss the final contenders with a knowledgeable salesperson or consultant.

#### Hard Disk

For the company that manages a great deal of information, a hard disk provides the greatest benefits. Although it's usually the most expensive addition to a computer system (typically \$1500 to \$3000), the hard disk offers tremendous amounts of storage, is relatively easy to use, and operates more rapidly than floppy disk drives. If used as a centralized disk from which information is shared, a hard disk can support several computers in a network.

Some hard disk drives for the PC can be installed internally (in place of one of the regular floppy disk drives). An internal hard disk significantly reduces the fan noise of external units and makes efficient use of space in smaller offices. External units are mounted in cabinets designed to complement the PC's styling. Tecmar offers a subsystem cabinet that is identical to the PC system unit. Inside are a separate power supply, additional expansion slots, and the hard disk drive in either 5- or 10-megabyte versions. Two alternatives are the new XT, which comes with a hard disk installed, or the IBM hard disk expansion unit for both the PC and the XT.

Computer consultants report that businesses frequently forget about data backup. This issue becomes important when you are dealing with the large amount of data stored on a hard disk. Critical data may be next to impossible to duplicate without a backup system. One consultant says that some of her clients had thought they could effectively rely on floppy disks to back up data from a hard disk. They had never stopped to realize how much time and energy this



## ● Community

backup method would take each day. Various backup systems are available. Corvus has designed a system that stores backup data on a videotape recorder.

### Increased RAM

The memory expansion obtained with RAM boards is cheaper and more easily accomplished than the storage expansion a hard disk provides. Anywhere from 64K to as much as 512K can be obtained on memory expansion boards for the PC. Prices range from \$200 to \$1000. The additional memory is helpful with many programs. With more memory, for example, *WordStar* performs print spooling and block moves more efficiently, and *VisiCalc* produces larger spreadsheets. An added benefit of RAM boards is that they don't use desk space.

Many manufacturers include electronic disk emulation software free or at a nominal charge with the purchase of a RAM board. This software addresses available memory just like a disk drive. Electronic disks function with much greater speed than mechanical disks. One risk involved in using electronic disks, however, is that all stored information is erased if the power fails or is turned off. As a result, data must be transferred to some other medium or it will be lost.

Electronic disk emulation is especially useful to businesses that have heavy word processing demands, because it allows faster access to data than mechanical disks. Even mass mailings on a limited scale can be handled when appropriate mail-merge software and an address list are loaded onto the electronic disk.

Competition has brought multi-function RAM boards into the picture. With only five slots in the PC main system unit, expansion space is at a premium. Adding combination boards is an easy way to ensure system growth in the future, and they usually don't cost much more than boards containing RAM alone.

### Software Utilities

Perhaps the most cost-effective purchase for increased productivity is a multitasking program such as a print spooler, which dumps a file to be printed into memory and frees the PC to handle other chores. This type of software usually costs under \$100, so it should bring an immediate return on the investment as a result of time and salary savings. Using multitasking programs in conjunction with RAM expansion should further increase productivity.

### Rating System

To decide which method of storage and memory expansion is likely to bring the highest return on your investment, use a comparative rating system. First, list the hardware and software options under consideration and then your business goals in order of priority. Assign a weight to each goal according to its priority. Out of four priorities, for example, the highest priority receives a weight of 4, the next highest a weight of 3, and so on.

#### Hard Disk

Access time faster than floppy disk drive  
Flexible, relatively secure mass storage  
Easy to connect and operate  
Requires extra controller board and modification of PC-DOS to address hard disk  
Backup more difficult than floppy disks (can use removable cartridge, cassette tape, and videotape)  
Large external units require additional office space; internal units replace one floppy drive inside PC chassis  
Some units may have objectionable fan and operating noise  
Can operate in a network environment  
Illegal to transfer copy-protected programs to hard disk  
Expensive: \$1795 to \$5000

#### RAM Board

Extremely rapid access (faster than hard disk) to electronic storage; certain programs (*WordStar*, *SuperCalc*) will operate more rapidly  
Data stored in RAM subject to loss through power outages  
Easy to operate  
Easy to copy data to other medium (floppy disk or hard disk)  
No desk space required  
Quiet; fully electronic  
Other functions (clock/calendar, additional printer ports) combined on some boards  
Electronic disk emulation and print spooler software increase flexibility  
Moderate Cost: \$200 to \$1000 (depending on optional functions such as clock/calendar and printer ports)  
Electronic disk emulation software free or at a nominal charge with purchase of RAM board

#### Software Utilities

Permit multitasking such as print spooling  
Operation easy and fast; improve productivity and speed of office tasks  
Quiet  
Inexpensive: \$40 to \$150

**Table 1: Business Considerations for Hard Disk, RAM Board, and Software Utilities**

Next, assign a score to each option according to its ability to achieve your goals. For example, if mass storage takes your number one spot, give the hard disk the highest score, say a 10, and the other devices proportionally lower scores. If speed and ease of operation weigh more heavily in your business, give the high score to RAM expansion. Do the same with each business goal.

To produce a score that reflects the importance of each option in relation to your business goals, multiply the assigned weight of a goal by the assigned score of an option. Total the scores and see which option brings the greatest benefit.

The following discussion takes the hypothetical XYZ Company through an analysis of the best hardware and software options to meet its business requirements.

#### The Business

XYZ Company sells office supplies and equipment to small- and medium-sized businesses throughout a city of some 500,000 people. During each of the past three years, XYZ has shown a 10 percent annual increase in sales, which has been mostly offset by inflation. This year, as a result of the poor economy, the firm expects income to remain flat, with sales of

computer. Smith purchased inventory, spreadsheet, and word processing software. The company's budget prohibited additional purchases.

Smith is now interested in accounts receivable and accounts payable management. While the company could rely on its floppy disk drives for the bulk of its current requirements, Smith realizes account management would be easier and quicker with larger mass storage. At the same time, she wants to manipulate more of XYZ's sales and inventory records to predict sales trends. However, sales analysis software requires at least 128K of memory.

Weight Factor	Business Goals (in priority order)	Hard Disk		RAM Board		Sales Analysis Software		Accounts Receivable/Payable Software	
		Assigned Score	Weighted Score	Assigned Score	Weighted Score	Assigned Score	Weighted Score	Assigned Score	Weighted Score
4	Sales Analysis and Projections	3	12	10	40	10	40	1	4
3	Cost Containment	2	6	10	30	8	24	8	24
2	Ease of Operation	7	14	10	20	3	6	5	10
1	Improved Business Management Techniques (accounts receivable/payable)	8	8	5	5	5	5	10	10
Total Scores		20	40	35	95	26	75	24	48
Price Range		\$1795-\$5000		\$200-\$1000		\$350-\$500		\$800-\$1000	

Table 2: Comparative Rating System for XYZ Company

Finally, decide which of the highest-scoring devices are most affordable. If the top-scoring choice exceeds the budget, consider the second choice or a combination of less expensive alternatives. The process of elimination will determine the most beneficial, cost-effective options for your business.

approximately \$1.5 million. XYZ maintains some 650 regular accounts and has from 100 to 150 walk-in customers daily. The average sale involves seven items totaling nearly \$100. XYZ extends 30-day credit to its regular clients.

Last year, to help track inventory and handle correspondence, XYZ invested in an IBM PC with 64K of memory and two double-sided disk drives. Smith, the owner, and her assistant are the only people using the

Complicating matters, a new office-supply company down the street with extremely competitive pricing has begun to attract XYZ's walk-in retail traffic. XYZ's budget allows the firm to spend a maximum of \$4000 for both hardware and software this year. But obviously the company would like to keep overhead low by reducing expenditures for fixed assets.



## ● Community

XYZ's dilemma can be summarized this way: the firm could concentrate on the relatively inexpensive RAM card and see much more immediate amortization of the cost. Or it could select a hard disk and opt for a more long-term capital expenditure, which conceivably could result in manpower and other overhead savings.

### Goals

To begin a logical analysis, Smith reviews the business' needs and establishes a list of goals for any new PC accessories, including secondary areas of convenience such as ease of operation, space, and noise. Next, she examines the time spent each month on bookkeeping. While the firm could realize some manpower savings through automating its accounts, competition is the more immediate concern.

XYZ is reasonably secure in its steady corporate customer base because the new firm refuses to extend credit. But walk-in business appears vulnerable. In spite of its inventory control system and an attempt to hold the line on prices, XYZ is having difficulty meeting the price competition from the nearby store. XYZ must continue to attack overhead and excess inventory, and reexamine its market position.

Smith believes her money will be better spent on a more powerful system for analyzing and forecasting sales and reviewing XYZ's market segment than on automating the firm's account management techniques. Analysis of current sales could lead to better inventory control. This in turn would help hold down costs and reduce lost sales resulting from items not being in stock.

So Smith values the company's need for automated accounting systems below sales analysis. Although these systems would be helpful, Smith decides XYZ's manual systems could be used for another year.

XYZ's final business priorities are: 1) sales analysis and projections 2) cost containment 3) ease of operation and 4) improved account management techniques.

### Options

Smith then evaluates the hardware and software best suited to XYZ's requirements. First she reviews hard disks and RAM expansion boards. Earlier research showed the importance of increased internal memory with RAM for any complex analyses. While a hard disk would make account storage more efficient, without the expanded memory the hard disk really couldn't assist the store's im-

---

**Purchasing additional storage for the PC should be approached in the same way as purchasing any large fixed asset.**

---

mediate goals of sales analysis and cost containment. The sales analysis software is a higher priority than the accounting software because it addresses the firm's primary goal of achieving a better competitive position; however, accounting software would reduce labor costs.

### Rating

Smith lists XYZ's business requirements in order of priority and then lists the hardware and software options that could support those requirements, as well as the cost of each. She judges the ability of each option to achieve every goal by using the comparative rating system described earlier.

For sales analysis and projections, Smith assigned the hard disk 3 points, cost containment 2 points,

ease of operation 7 points, and improved business management techniques 8 points—a total score of 32. She applied the same approach to a RAM board and the sales analysis and accounting software (see Table 2).

Upon reviewing the capabilities and costs of both software packages, Smith finds a hidden benefit. With the money saved by not purchasing a hard disk this year, the company could purchase the accounting software as well as the RAM board and sales analysis software. With the accounting software in place, XYZ could begin to phase in an automated business management system this year, thus accomplishing an even lower priority goal. Total cost for all purchases would run approximately \$1900: \$400 for a multifunction RAM board, \$500 for the sales analysis software, and \$800 to \$1000 for the accounting software.

The succinctness and flexibility of this comparative rating system make it ideal for analyzing the cost versus the benefits of any major purchase. Additionally, for those who use a spreadsheet program, the listing and scores fit the format of *VisiCalc* or similar programs. With a spreadsheet, managers can perform any number of "what if" analyses to see how various combinations satisfy both business requirements and budgetary restrictions.

Small businesses can easily follow the four-step analysis presented in this article. After doing so, a company can rest assured that its decision about storage and memory expansion has a foundation in a logical appraisal of reasonable alternatives, rather than leaving decisions concerning profitability to luck.

---

*Mark Phillips specializes in business and financial writing in the Seattle area.*



**T**he printer is to the computer system what the speaker is to the stereo: it is the device that enables the computer to communicate with the outside world. And the choice of printer is as important to the usefulness of your computer system as the speaker is to the performance of your stereo.

## HOW TO CHOOSE A PRINTER FOR **Your Personal Computer**

BY BRUCE THATCHER

■ Choosing the right printer among the hundreds available can be very confusing. How fast should your printer print? How much should you spend? What kind of print quality should you choose? How do you know whether the printer will work with your computer?

The need for a printer with a personal computer is threefold. First, computer output is easier to read on paper than on a video display terminal. Second, printed output provides a hard copy record of the computer's transactions. And third, a printer enables a computer user to share information with others.

Printers are used in so many places and for so many applications that no one model — or even one technology — answers all users' needs. For some users, speed (or "throughput") is the single

Bruce Thatcher is Director of Peripheral Product Marketing for NEC Information Systems, Inc. based in Lexington, MA.

most important factor. For others, it's the print quality. For still others, the most important factor is low cost. The printer marketplace has grown right along with users' needs, and printer manufacturers are constantly developing new technologies to meet those needs, as well as refining the technologies employed in existing printers.

All computer printers fall into one of two broad categories: impact or non-impact. The print head, an electromechanical device, controls the speed and output quality of most printers.

Non-impact printers transfer images to paper without actually striking the paper. Some inexpensive non-impact printers employ thermal or electrostatic print head technologies. Lower-quality printing and high paper costs deter these printing methods for many users. Ink-jet printing,

LIST

*"How to Choose a Printer for Your Personal Computer," Bruce Thatcher, LIST, Spring 1983, pages 108-110. Reprinted by permission. Copyright (c) 1983 by Redgate Publishing Co. ALL RIGHTS RESERVED.*

PPR 110

while high-quality and high-speed, is expensive, requires selected paper, is not very reliable and is available in only a handful of models.

Impact printers employ a mechanism for striking paper through a ribbon like the one in a typewriter. What actually strikes the ribbon is either a fully-formed character or a set of pins that form a character.

The print thimble, daisy wheel, print cup and golf-ball print mechanism are used with fully-formed character printers. Their chief advantage is the ability to print characters that look as though they were produced by a typewriter or printing press. Character sets, or sizes, may be changed on fully-formed character printers by a change of the thimble or wheel.

Despite the acknowledged use of computers in virtually all business environments, resistance yet remains to a work product that looks computer-generated. Documents bearing corporate letterhead, in keeping with the corporate image, destined for delivery outside of the office are more appropriately printed by a fully-formed character printer.

## C HARACTER PRINTERS

As the personal computer buyer may soon outgrow the memory, or electronic storage of information on silicon chips, or the system by the creation of an ever-expanding database, so too may the printer become outmoded unless it features the versatility and flexibility that only a fully-formed character printer can provide. A well-planned printer purchase will include consideration of the volume of forms processed by many businesses every day. A variety of user-installable forms handler can substantially reduce time-consuming forms preparation and thus benefit productivity.

The fully-formed character printer is not without trade-offs, however. They include relatively high cost, and slow speed, with multi-copy letter quality output at 20 to 60 characters per second (cps).

## D OT-MATRIX PRINTERS

Dot-matrix printers, which are faster and typically less expensive, strike the ribbon with pins carried in one or more

matrix print heads. One advantage of the dot-matrix printer is that it can print more character sets — even foreign languages — without changing heads.

The print head or heads in a dot-matrix printer hold a series of pins (sometimes called needles) that strike the ribbon in matrix pattern, with one predetermined pattern for each letter or number to be printed. The design of the print head must be such that the pins strike the ribbon with just enough force to produce a clear imprint. The more dot imprints there are in the character, the closer it comes to approximating a fully-formed, typewriter-like character. Typically, print heads have a 9 x 7 or 9 x 9 matrix, although newer ones can have a matrix as large as 18 x 6.

Dot-matrix dual-pass printing improves print quality without adding additional pins, where the print head makes two passes across each line of print, with the dots in the second pass slightly offset. The effect is to "fill-in" each letter, increasing density and thus its legibility, while reducing the effective print speed.

The leading drawback of dot matrix printers is the print quality. For documents that will remain in-house, such as memos and status reports, these printers will adequately address printed document needs. The low cost (the dot-matrix has fewer moving parts) will likely prove attractive to users with limited document distribution.

Low cost dot-matrix printers print unidirectionally, like a typewriter. That is, the print head prints from left to right and then returns to the left side of the page before starting the next line.

## T HROUGHPUT

Bidirectional printers print one line from left to right and the next from right to left, increasing throughput. Some printers increase throughput further with "look ahead" or "short line seeking" logic. With this print method, the printer searches its memory while one line is printing to determine the optimum place to begin printing the next, so that the print head does not waste time passing over empty spaces. This is particularly useful for applications in which printer volume is important.

Print heads vary in the number of characters they will print before wearing out. Some will print more than a half billion characters before they need replacing and are considered permanent. Others must be replaced more frequently and are considered disposable.

One company that manufactures printers offers a ribbon with a life of more than 400,000 characters for the first pass, producing letter-quality characters. The ribbon is then flipped over, printing 400,000 correspondence-quality imprints, and can be turned again and again, to print hundreds of thousands of draft quality characters.

A serial printer has one print head and prints one character at a time, in series. A line printer has a number of print heads which strike the paper simultaneously, printing an entire line at a time. Line printers are faster than serial printers, so they are particularly useful for very heavy workloads. They are also more expensive.

## I NTERFACING

The signals that determine what the printer will print are generated by the computer, and they must be conveyed from the computer to the printer in a form in which the printer can receive them. The device that enables two electronic devices to communicate with each other is called an interface.

The interface is usually a printed circuit board and cabling which together act like a translator. There are many kinds of interfaces, but they all fall into one of two categories: they are either serial or parallel. If the computer sends all the bits of data needed to generate a character one at a time along a single wire, the printer needs a serial interface.

If the computer sends all the bits needed to generate a character simultaneously along parallel wires, the printer must have a parallel interface.

Serial transmission is slower, but can be used over longer distances. Serial transmission is also used whenever the computer and the printer must communicate over a telephone line.

Serial transmission may be either synchronous or asynchronous. In synchronous transmission, the computer must know exactly when each bit is to be transmitted to the printer. This means there must be a precise timing clock built into the transmission mechanisms.

With asynchronous transmission, the receiver (printer) and the transmitter (the computer) are synchronized by a start bit and a stop bit for each character. The number of bits transmitted per second is called a "baud" rate.

All the printer buyer needs to know is what type of computer he has: IBM, Apple, NEC. The dealer will recommend the right interface.



## P APER HANDLING

Printers employ three kinds of paper feed mechanisms: friction feed, pin feed and tractor feed.

With friction feed, single sheets of paper are fed through the printer just as they are in a typewriter: gear-driven rollers hold the paper in place, and move it up when it is time to print the next line. The user must either feed the sheets through manually or use a device called a "cut-sheet feeder," which feeds the sheets through automatically.

With a pin-feed printer, you can use "continuous forms": rolls of paper with horizontal perforations at regular intervals and sprocket holes along the sides. Metal pins on the rim of the printer's platen, or roller, fit into the sprocket holes in the paper to keep it aligned as it feeds through.

The limitation of the pin feed mechanism is that it accepts only one width of paper. With a tractor-feed mechanism, the pin feed sprockets are adjustable so you can use varying paper widths—typically from three to 16 inches.

Your choice of printer should be dictated by what you're going to do with it. If you need print quality that looks as though it came out of a typewriter or off a printing press, you may need a fully-formed character printer. If you simply need a low-cost printer to use once in a

while, one that prints 80 to 132 characters per line on 8 1/2 x 11 paper will probably do the job. If you want a faster printer that offers block graphics and prints on paper up to 16 inches wide, buy one that prints 136 to 224 characters per line at 120 cps. For correspondence print quality, dot addressable graphics and speed, look for a printer that prints from 200 to 350 cps, with up to 231 characters per line.

## R ELIABILITY— THE KEY FACTOR

The single most important factor to consider in choosing a printer is probably reliability — both of the printer itself and of its manufacturer. The best printer in the world would be a bad buy if the manufacturer could not supply parts or you could not find a place to have it serviced. As with anything else, it pays in the long run to choose a printer made by a reputable manufacturer — one with a long history of providing quality equipment and service. The quality will not necessarily translate into a higher purchase price. Quality is a function of a design decision at the start of the manufacturing process where it is built in along with reliability.

In deciding how reliable a particular printer is likely to be, ask about its MTBF and MTTR ratings. MTBF means "mean time between failures," and the rating is usually given in hours. If a printer's MTBF rating is 4000 hours,

that means testing by the manufacturer has shown the printer will typically run for *at least* that long before anything goes wrong — probably longer. MTTR means "mean time to repair," and is usually expressed in minutes. A 15-minute MTTR means it usually takes about 15 minutes to repair that particular printer.

Buying a printer is a little like buying a car — making the right choice is a matter of weighing alternatives and deciding what features and options you need.

The difference is in the range of options. Printers range in price from about \$300 to more than \$500,000. Obviously, the person shopping for a printer to be used at home or for a small business will be looking for one priced on the low end of the range. After deciding how much you can afford, your choice becomes a matter of deciding what speed and features you need and want.

Printer manufacturers are constantly seeking new ways to increase throughput, improve print quality, and increase the printer's useful life. There are already dot-matrix printers with variable matrices that provide different speeds and print qualities for different applications. And soon printers will have self-diagnostics: they will, in effect, be able to tell the user what's wrong.

As the cost of memory comes down, printers will have even more buffer (memory) storage than they have now. They will be part of electronic newspaper and mail systems in the homes and offices in the years ahead.

For the printer, as for the computer, the possibilities for the future are infinite.



# COMMUNICATIONS

## The Basics of Modems

*What to look for in a modem — from asynchronous dial-ups to synchronous full-duplex capability.*

by Kenneth R. Guy

When Alexander Graham Bell invented a device that allowed people to talk to each other over wires, he did not know that someday business machines would communicate over the same wires. Since the telephone network is designed to carry the continuous tones of the human voice, it cannot handle digital patterns unless a conversion process takes place. Telephone equipment is compatible with the analog sounds of the human voice, but it is unable to handle the on/off or Morse Code-type signals of a business machine.

However, a terminal or other data communications device can transmit information over phone lines if the digital output of the business machine is converted to analog format. The conversion from one transmission scheme to another is accomplished by modems. In effect, a modem MODulates a digital signal into analog form and DEModulates the analog signal back into digital form at the other end. Thus, the word for modem is derived from the process for which it is used.

In normal practice, a modem must be used at each end of a data communications line. First, the digital output of a business machine must be changed into analog form for transmission over the phone network. When the transmission reaches its destination, the analog information must be changed again into digital form so that it can be understood or read by a computer or other business machine. (See Figure 1.)

When humans talk over telephone connections, they use certain procedures to greet each other and establish who is calling. Machines also must use handshaking and similar electronic sequences so that an orderly exchange of information can take place. Data transmission can occur in either asynchronous or synchronous modes.

Asynchronous mode involves the transmission of individual characters each time a key is pressed by a terminal operator. Devices which utilize this type of transmission generally have no buffer, so the communications link remains in a wait mode until the next key is pressed. Asynchronous (or start/stop) devices generally operate at low speeds ranging from teletypewriters at 50 bps up to terminals which transmit at 2,400 bps. Depending on modulation schemes and similar technical criteria, the upper limit of asynchronous data transmission is in the 1,800 to 2,400 bps range.

Most asynchronous modems use frequency modulation or FSK (frequency shift keyed) modulation. These modems transmit a signal at one frequency to indicate a space, and they transmit at a different frequency to indicate a mark. The most popular modems in this class are the Bell 103/113 which operate at 300 bps and the Bell 202 which operates at 1,200 bps. Modems from independent suppliers are often described as being compatible with

one of the basic Bell modem types. Since modems are needed at each end of a line to modulate and demodulate, they must be used in pairs which are compatible, since they must use the same modulation scheme to talk to one another.

While asynchronous transmission is suitable for low-speed, low volume data, higher speeds and continuous data streams require a more efficient line utilization method. Synchronous modems transmit characters in a continuous transmission with no break between each character. (See Figure 2.) Both transmitting and receiving modems must maintain exact timing through the use of an oscillator or "clock" which synchronizes the units. A continuous stream of characters is divided into blocks. A wide variety of block lengths are possible, from only a few characters to hundreds of characters. Characters are stored in a buffer until a complete block has been assembled. The block is then transmitted at the maximum speed of the modem together with added bits of information used for error checking and similar housekeeping functions.

Synchronous-transmission modems begin at 2,400 bps and can range to much higher speeds, limited mainly by the upper boundaries of available technology. From a practical standpoint, the upper limit of modems available for standard voice lines is 9,600 bps. Beyond that speed, special line quality and other technical character-

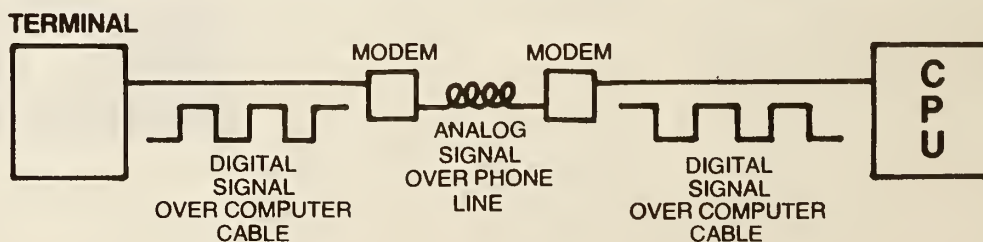


Figure 1

## COMMUNICATIONS

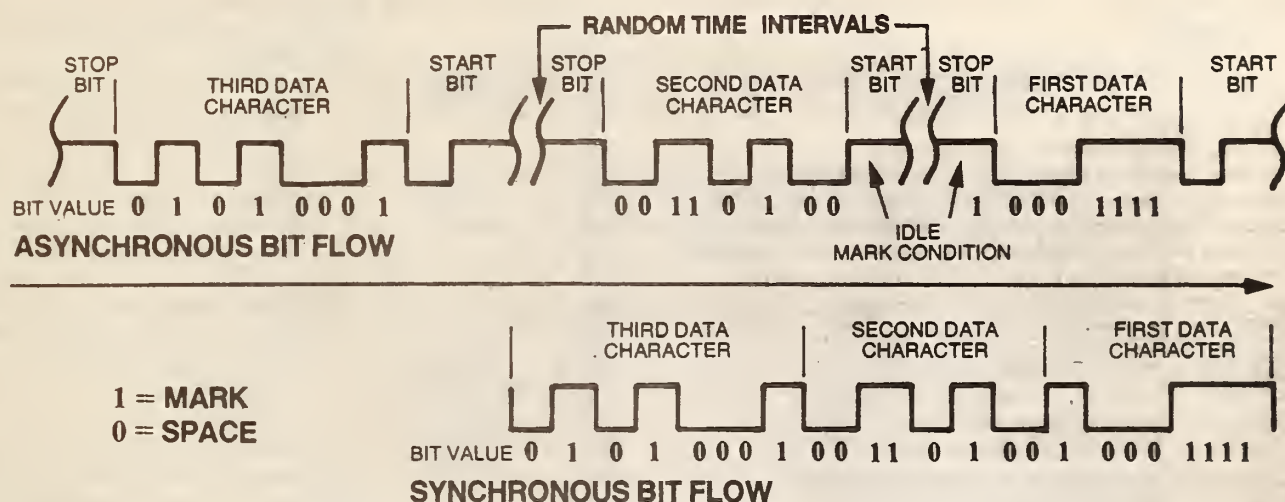


Figure 2

istics are needed. Synchronous modems employ a variety of modulation schemes which become more complex at higher speeds. The Bell 201 modem operates at 2,400 bps in synchronous mode and nominally defines this class of unit. The Bell 208 modem operates at 4,800 bps and the Bell 209 operates at 9,600 bps, but neither of these higher speed devices have a common set of characteristics. Many independent suppliers produce synchronous modems at higher speeds that are not compatible with Bell units.

Data can be transmitted over a telephone line in several ways. When a line operates in half duplex mode, data travels in each direction, but only one data stream in one direction can be handled during a given time period. If terminal A transmits to terminal B, then B must wait to reply to A until the first transmission has been completed. The line is then turned around in that B transmits to A and data flows in the opposite direction. When full duplex transmission is employed, A can transmit to B at the same time that B is also transmitting to A.

The most common mode of transmission is half duplex since most terminals cannot handle two-way communications at the same time. Full duplex facilities may be used to transmit data in one direction, while the second data path is used to collect control information to monitor the status of the communications link. It is also possible to use a data link in "simplex mode" — data traveling only in one direction. This is seldom used for data transmission since there is no return information path.

### Dial-Up vs. Private Lines

Each of the data transmission attributes described thus far can be used on either dial-up or private lines. As the name implies, a dial-up line is established when the site that wants to transmit data dials the number of the site that will receive the data. The connection is established through existing telephone company central offices over the public switched network. Dial-up lines can be expensive for data users. Long distance calls are charged on a time-sensitive, minute-by-minute basis that can make lengthy data transmissions uneconomical. However, when data is transmitted on an infrequent schedule to a number of different locations, dial-up lines are usually the best type of connection.

Users who transmit large amounts of data on a regular basis to a fixed location may also use private (or leased) lines. These lines are technically similar to dial-up facilities but they are reserved and continually available for the exclusive use of the customer. In effect, the business organization reserves a discrete path through the telephone system from point A to point B for a fixed monthly charge. If a user can transmit data over a private line for enough hours each month to justify the fixed cost, then a private line is usually more economical than dial-up connections. In order to make an exact comparison between the cost of dial-up and private lines, such factors as transmission length (in miles) and total time of data calls, must be carefully evaluated along with cost of modems, terminals, etc.

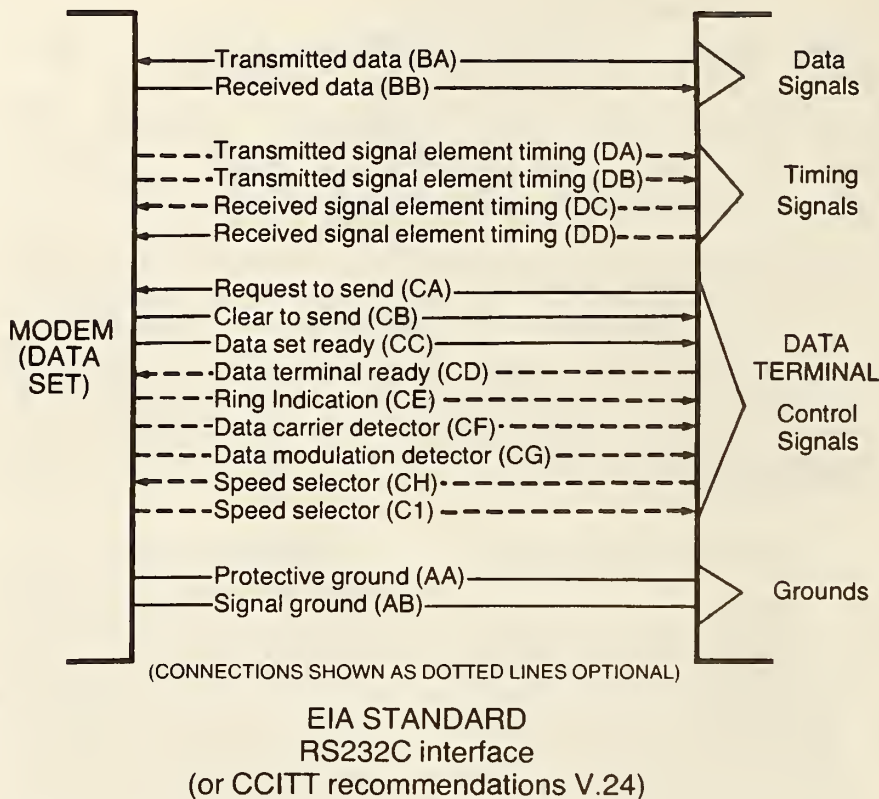
Some customers utilize a private line for both voice and data. Many modems include a switch that allows normal voice conversations when data is not being transmitted. Private lines give users more control over the communications link and allow the utilization of phone company conditioning to control noise interference. It also allows users to perform line tests to assure that their transmission is not interrupted by degrading line quality. An important benefit of private lines is the ability of the user to install equipment that will allow the use of multiple data streams so that line utilization can be optimized.

In order to standardize the connection of modems to terminals and business machines, the Electronic Industries Association (EIA) has developed a common standard. Designated the EIA RS232C interface, the standard defines a pin arrangement of data signals, timing signals, control signals, and ground wires that are needed to complete data transmission over a dial-up or private phone line. (See Figure 3.) The RS232C connector is the most commonly used method of linking terminals and modems, and it is functionally similar to the CCITT V.24 interface that is used for the same purpose in other countries.

Modem technology changes rapidly. Hardware costs are decreasing while modems are becoming more sophisticated with features designed to avoid errors and improve the reliability of data transmission. Most modems have indicator lights to signify that communication lines are operating correctly. This is usually provided by indicators that correspond to the most im-



## COMMUNICATIONS



**Figure 3**

portant signals in the RS232C interface. For example, when a connection is established with the phone line (or data carrier), a carrier indicator will be illuminated. This tells the operator that the phone line is ready for data transmission.

Many modems also have features to check the status of a line between modem pairs by sending a test signal. This type of loopback shows the operator whether the line can send data in both directions correctly. Loopback tests are also available on more advanced modems to check whether modems and their attached business machines are functioning correctly. Modem and line testing can become highly technical with the use of specialized diagnostic equipment. This level of expertise is normally employed on nationwide private-line networks that must remain operational 24 hours per day.

Most users can get by with less demanding test capabilities. Dial-up customers often keep spare modems available to help isolate faults. When a malfunction in a modem is suspected, an operator can substitute a spare unit to see if the problem is eliminated. In the same way, an alternate dial-up line can be called up if line

problems are affecting transmission. Private line users can configure their modems to switch to dial-up connections when a failure is detected in the leased line.

Many modems now perform automatic functions that previously had to be initiated by an operator. An automatic-answer feature allows a modem to respond to an incoming call and automatically connect to data terminal equipment (DTE). This capability is useful at a remote site which has data stored in a terminal and ready to send. During night-time hours, when data traffic drops off or dial-up rates are lower, a computer center can dial the remote site and receive the previous day's business information — all without the intervention of an operator. Modems with auto dial features have similar capabilities in the areas of initiating calls automatically.

### Modem Costs

Modem costs are a moving target. The general trend incorporates steadily increasing features at progressively lower costs. Many suppliers provide volume discounts for large purchases, and total cost may also depend on whether on-site maintenance is needed. For customers

who operate with several lines and a small number of modems, the following price ranges apply:

- A 1,200 bps dial-up modem with intelligent auto dial is priced between \$550 and \$1,000.
- A 2,400 bps full duplex dial-up modem costs just under \$1,000.
- In the synchronous modem domain with full-duplex capability and a standard array of test features, a 2,400 bps unit ranges from \$650 to \$750; a 4,800 bps modem costs between \$1,600 and \$1,800, and a 9,600 bps device ranges from \$2,500 to \$3,000.

Customer data needs typically expand and network requirements escalate. As equipment becomes more powerful, users often can improve the utilization of existing phone lines by acquiring more versatile transmission devices. It is common for large corporations with national networks to save thousands of dollars per month of existing phone bills by transmitting multiple data streams over existing phone lines. Users transmitting less data can employ similar methods to enjoy economies of scale that produce higher transmission throughput at lower cost without upgrading existing facilities.

A typical data user with a VAX processor at a central site may operate with two data lines to a remote location. A 300-bps line operates with teleprinters to send administrative messages between the two locations. A higher speed 1,200-bps link is utilized to send order-entry information from a remote display terminal to a VAX processor.

Such a company might expand the remote location by installing seven more display terminals to handle the sharp rise in orders. The company might look for ways to avoid using a separate phone line with two modems for each communicating terminal, a total of 14 additional modems and seven new data lines. The manager of data processing might investigate the possibility of installing a pair of 2,400 bps modems, together with a pair of multiplexers, to concentrate the individual terminal data onto a single phone line. This option appears to offer increased transmission capability at lower cost. [E]

*Kenneth R. Guy is direction of sales and marketing of ComDesign Inc., Goleta, Calif.*

*(Editors Note: Next month Kenneth R. Guy will discuss the basics of multiplexers).*



## **6. SOFTWARE**

# Software Evaluation

By  
Michael Hammer

...sudden fascination? One reason is that hardware is increasingly becoming a commodity, both literally and figuratively. There is growing standardization (or at least similarity) among the hardware components that form an OA system. Systems integrators have been increasingly acquiring these components from the same small set of suppliers. As a result, both value-added and differentiation are more and more often coming from the soft areas: service, marketing, support and, in particular, software.

Moreover, the last three to four years have seen the flowering of software packages, especially in the office systems arena. Until recently, office systems software was almost always bundled with the hardware: it was developed (directly or otherwise) by the systems vendor and sold together with its hardware base. As a result, the customer typically bought a complete, fixed-function system. The notion of software as a separately configured, priced and purchased product was not widespread.

**H**istorically, software products (packages) were confined to relatively narrow segments of the DP industry. Although packages were built and sold in wide varieties, their major successes were in three areas:

- Large-scale and complex system software products, such as data base management systems, whose construction would have exceeded the capacity of user organizations.

- Nonstrategic applications for large DP users — typically financial applications from payroll to general ledger — where the advantages of in-house development (in terms of functionality) were more than outweighed by the cost, timeliness and reliability advantages associated with package acquisition.

- Applications for small organizations with neither the expertise nor the resources to develop software themselves.

The personal computer was a

major force in bringing the software package to the office environment. The personal computer delivers to an individual's desk the computational resources of a significant general-purpose computer. Software is at the heart of this capability. Such an individual could not be expected to write all required software, and a host of suppliers sprang up to develop and distribute this software.

For the first two years of the personal computer era, personal computing and office automation were widely viewed as disjoint. OA products were closed-end, limited-function devices without even the capability of running additional software. More recently, however, the industry has recognized that lurking under every OA product is a general-purpose computer, capable of supporting additional software packages and thereby acquiring a broader functionality.

**"The industry recently recognized that lurking under every OA product is a general-purpose computer that can support additional software."**

It is now widely recognized that the personal computer is a fundamental component of an office system, and personal computer-like capabilities (in the form of personal computer operating systems) are increasingly being added to products otherwise labeled office systems. As a result, individuals responsible for OA must now also develop guidelines and techniques for evaluating and acquiring software packages for personal computers and office products.

This responsibility represents a major new challenge to OA and DP groups. Vendors developing OA software and distribution chan-

**A** new cliché is abroad in the land of office automation. Pundits, analysts and commentators have concluded that software, not hardware, is the key component of an OA system.

Software is clearly the rage. Venture capitalists are falling over each other to fund the start-up of new software companies, and existing companies are being bought out at incredible prices. This discovery of software comes as a surprise only to those who regularly watch television when nothing is being broadcast. Except in the case of a few old hard-wired machines, the functionality of a modern office system is delivered by software applications running on a hardware base. Hardware is just a pile of electronics until complemented by software. Why, then, the

nels that bring these products to the customer differ significantly from those with which many organizations are comfortable and familiar. In addition, OA and personal computer software systems have different characteristics and objectives from software products used in more conventional DP environments. For these reasons, organizations must develop criteria and means for assessing the appropriateness and quality of software products.

The contemporary software scene is awash in hyperbole and clichés. Such terms as "powerful," "flexible," "user-friendly" and "easy to learn" are tossed about with careless abandon. No one is quite sure exactly what these terms mean. However, everyone seems to agree these characteristics are all good things, and all vendors are certain their packages have them in abundance.

More than any other, the issue of user interfaces and their ease of learning and use is one in which imaginations are given free rein and extravagant claims are the norm.

**T**horeau once said, "Patriotism is the last refuge of the scoundrel." Today, that remark might be better applied to "user-friendly." There is no agreed-upon definition for the term nor any standard for what constitutes a truly usable system. "Ease of use" often seems to be like pornography: We may be unable to define it, but we know it when we see it.

"Ease of learning" and "ease of use" are often used interchangeably. The two concepts have some relationships, but they are quite distinct and often antithetical. On the whole, ease of learning refers to the simplicity with which a novice casual user, unfamiliar with the system, can develop a sufficient comprehension of the system and its capabilities to accomplish some useful work with it. Ease of use usually refers to how readily a more sophisticated and experienced "power" user can exploit the potentials of the

system. The factors that make a system easy to learn are often very different from — and in fact may be inconsistent with — those that make it easy to use.

The key issue in making a software package easy to learn is to reduce the user's anxiety factor by making the system as familiar as possible. A system is easy to learn if in fact there is not very much new about it that the user has to learn. The goal is for the user to approach the system already familiar with many of its concepts and much of its terminology. A system that requires a casual user to learn a new mode of thinking and an entirely new vocabulary can prevent a novice from coming to grips with it. All too often, computer jargon finds its way into systems designed by even the most well-intentioned.

To a non-technically oriented individual, software systems appear to operate by magic, and this

**"A system that requires a casual user to learn a new mode of thinking and new vocabulary can prevent a novice from coming to grips with it."**

is often overlooked in user interface design. Users who do not possess an understanding of the internal operation of a system treat it like a black box and induce a model of its operation from their observation of its behavior. People inevitably build conceptual models of tools they use. Such models are not expressed in technical terms, but in terms of elements and structures from other domains with which the user is familiar. (For example, the user of a word processor may think of his screen as corresponding to a sheet of paper and the operations performed as corresponding to activities that could be done with a



# FOCUS

typewriter.)

It is important that the user's conceptual model be operationally correct. A user should be able to predict accurately the effect of any command by thinking about it in terms of the analogous model basis for use.

An easy-to-learn system must be designed to be learned. Novices are rarely able to comprehend the full capability and utility of a system when they first approach it. They should not have to learn system facilities and concepts they do not need. In order to use those they do need, modular design is a principle that applies not only to the internal design of software systems, but to their interfaces as well. The style of an interface should be such that the user does not confront things he does not understand until he is ready for them. The command set should be organized in such a way that minimal subsets can be readily learned and used.

To reduce a novice's anxiety factor, the system should provide assistance, feedback and a forgiving working environment. Helpful system prompts, menus, on-line documentation and the ability to roll back regretted actions are among the techniques employed to achieve this kind of pleasant context.

**B**alanced against the factors that make a system easy to learn are those that make it easy to use for someone who has already learned it. The simplicity, helpfulness and friendliness that characterize an easy-to-learn system are usually annoying and often counterproductive for more experienced users. The experienced user has already internalized a model of the system and its capabilities.

For a "power" user, the principal design objective is efficiency. The experienced user knows what he wants to do and, usually, how he wants to do it. He needs a system that allows him to get his work done quickly and painlessly and that keeps out of his way. It should also provide a rich set of powerful tools. The casual user may find these tools sophisticated and even complex, and their number overwhelming. However, they offer relief from frustration and drudgery to a "power user," who has invested the requisite time in learning and understanding these features. While perhaps not user-friendly, a powerful and flexible system is often most usable because it allows a user to extract from the computer the maximum functionality with a minimum of overhead.

Thus, the designer of an easy-to-use system must anticipate the broad range of users' needs and provide a set of commands that allows such users to accomplish their objectives as directly and quickly as possible. Minimization of overhead and conceptual efficiency are key design objectives. The experienced user is likely to find a small set of easy-to-learn features terribly difficult to apply

to any interesting complex problem. The utilization of such primitives often entails additional steps, both in formulating a mode of attack and in carrying it out. The user wants a system that allows him to accomplish directly what he wants to do. A large collection of powerful commands is often the hallmark of an easy-to-use system.

However, simply tossing together every possible desirable feature, plus the kitchen sink, does not yield ease of use; it yields a mess. Consistency and a set of unifying principles are the glue that holds together what would otherwise be a chaotic collection of unrelated features. The entire system must have an underlying logic that, when appreciated by the user, provides a reliable means of remembering the system's capabilities and even deducing the meaning of new constructs. Even a sophisticated user will not use all parts of a system with equal frequency, and therefore requires assistance in remembering features used less frequently. Moreover, this user is likely to explore the fringes of a system, searching for advanced capabilities, and should be equipped to do so on his own.

Natural and familiar concepts may be inadequate to carry this off. But, although they may be individually complex, the set of principles underlying the system must be few in number. When basic concepts or exceptions to the rules proliferate, harmful complexity results.

Part of a system's efficiency is determined by how well it assists the user in avoiding errors and waste. The virtues of systems that allow for graceful recovery from mistakes have been well-publicized. Attention should also be given to design features that inhibit making such mistakes in the first place. Careful keyboard layout and command naming are major steps to achieving this end.

A frequent user should also be able to personalize the system, whether to rename commands in a fashion more congenial to him, to create new commands from sequences of old ones or to cause certain activities to be performed automatically at designated times.

In the best of all possible worlds, a system would be both easy to learn and easy to use. It would achieve this by presenting to the novice a subset of its capabilities that are useful, but not so powerful as to be intimidating. The user could acquire this easy-to-learn part of the system and gradually come to terms with its more powerful features.

Alas, such designs are rare, and not just because of the blindness of system developers. Many applications do not readily lend themselves to such a multilevel interface. In reality, we must confront the question, "How important is user-friendliness?" We must confront trade-offs and compromise. User-friendliness is usually achieved at the expense of some factor, typically system ca-

pability or ease of use for the more experienced user.

The question of the importance of ease of learning cannot be answered in general; it depends in a major way on the characteristics of the individual application. If an application has a very high value to the user, the interface must be as he has developed in his mind. Confusion, not ignorance, is the enemy of ease of learning. If a novice does not know what a command means, no great harm is done. Trouble begins when he incorrectly thinks he knows what it means and his observation of its behavior does not match his expectation. At this point, the user's frustration boils over; he throws up his hands and declares the system makes no sense. It is very important that the system be designed in such a way that the user's apprehended model of its operation provides an accurate very bad indeed to prevent him from using it. For applications of marginal value, where the user is not compelled to employ the system, a hard-to-learn interface may discourage a user from ever getting started.

**O**n the whole, the issue of user-friendliness is currently being overplayed. In the long run, the success of a software system will be determined more by functionality and ease of use than by whether it can be learned in one hour or two. The factors that militate toward ease of learning at the expense of other criteria are temporary and declining in significance. These include such issues as user populations unfamiliar and uncomfortable with computer systems, and a milieu in which the use of automated systems is still something of a novelty. We are inevitably heading into an era in which computer literacy is the norm rather than the exception, utilization of computer systems is the standard mode of operation and extraction of maximum capability from available tools is essential. In this environment, users can be expected to make the investment needed to learn a system, provided it offers them substantial functionality that can be effectively harnessed. In other words, the casual user may be an artifact and a transient phenomenon.

Which brings us to another contemporary fad: the all-inclusive, integrated software package that provides a range of capabilities, typically with a more or less consistent interface across the functions, as well as the ability to move conveniently from one subsystem to another. The particular functions vary from system to system, but typically they include word processing, records processing, spreadsheet and graphics tools. They may also include such things as electronic mail and a calendar.

Although it is certainly preferable to have a collection of integrated tools rather than the same tools on a nonintegrated basis, the sim-

ple fact of bundling and integrating these tools will not compensate for deficiencies in their individual functionalities. Office automation is not synergistic. A collection of mediocre components remains mediocre and does not achieve additional value because of its integration. As a rule, an office system user does not need rudimentary capability in a number of areas. Rather, the user requires extensive functionality in a particular area — the motivating application driving the use of the system. Other functions, while desirable, cannot be provided at the expense of the core capability.

Other factors besides functionality, ease of learning and ease of use contribute to the quality of an OA software package. The quality of the documentation, both as a learning aid and as an ongoing reference, is of major importance. The software itself is just part of

***"The success of a software system will be determined more by functionality and ease of use than by whether it can be learned in one hour or two."***

the extended product that includes the documentation, training and support provided by the vendor. The vendor itself must be evaluated as part of the software selection process. Can its claims be believed? Does it have the resources to remain on the scene at least for the expected lifetime of its products?

Although careful evaluation of prospective OA and personal computer software packages is indicated, a lengthy and costly evaluation process is often out of the question. User demand for software is very high, and an OA organization that delays its users while it conducts lengthy evaluations will soon acquire a reputation for heel-dragging.

In any event, there are too many software packages, with new ones being introduced all the time, to allow a user organization to do a thorough review of all the alternatives. OA departments will have to identify external sources of information and evaluation upon whom they can rely for assessments of software packages — assessments that will have to be interpreted in the light of the organization's unique requirements and experience. **OA**

*Hammer is president of Hammer and Co., a Cambridge, Mass., management consulting firm specializing in the impact of new technology. He is also an associate professor of computer science at MIT.*



## Copying Computer Software: What Risks, What Penalties?

**A** branch of the law specializing in computers and electronic information dates back to the first mainframes. Much of this early computer law was concerned with contracts with vendors for hardware and software. Today those and other concerns are coming into prominence with the advent of personal computers as a consumer purchase. Some of the legal questions raised by the development of personal computers are traditional legal questions recast for the electronic medium; others are wholly new questions raised by the personal computer's unprecedented capabilities.

In this new column on computer law, Personal Computing intends to explore these questions and what they mean to you, the personal computer user. This month the first column explores copyright law, and examines the legal implications of copying or modifying software. The column was prepared in consultation with Daniel T. Brooks of Computer Law Advisers in Springfield, Va. Involved with computer law for two decades, Brooks holds degrees in law and electrical engineering from Stanford University. He is also the secretary of the 10-year-old Computer Law Association, a professional society independent of the American Bar Association.

The author of a software package can protect his rights of ownership in four bodies of law: trade secret, contract, patent, and copyright. In fact, a given software package may actually be protected by more than one set of laws. But commonly, personal computer software is protected under copyright law.

Copyright is federal protection of

intellectual property. According to the 1976 Copyright Act, works written after January 1, 1978, are automatically protected by copyright. Registration of that copyright with the Copyright Office of the Library of Congress is an elective procedure.

Two elements are needed in order to take out a copyright—the author's ideas, and the tangible expression of those ideas. The idea for a plot of a novel is not subject to copyright, but the novel itself—the expression of those ideas—is. Similarly, the idea for a spreadsheet computer program cannot be copyrighted, but a specific computer program written to do the spreadsheet can.

Congress specifically intended the 1976 Copyright Act to cover computer programs as a subcategory of literary works. Compressing the substance of several sections of the Copyright Act into a single statement, copyright law protects 1) original works of authorship 2) fixed in tangible media of expression 3) from which they can be perceived, reproduced or otherwise communicated 4) directly or indirectly, with or without the aid of a machine or device 5) for a period of more than transitory duration.

Under the Copyright Act, the author of the computer program is the owner of the copyright. Generally the author of the program is the person who writes it. The major exception is for employees who wrote the program as part of their job; in that case the employer is considered the author. The copyright owner has five exclusive rights. He is the sole owner of the rights to reproduce his own work in copies, prepare derivative works based on the original, perform the work publicly, display the work pub-

licly, and distribute the work to the public. Those rights are divisible—that is, the owner can split them up and assign them to others as he desires. He can, for example, sell distribution rights for his program to a software manufacturer.

### *What the user gets*

What you get when you put down your money for the package in your local computer store depends on whether you acquired your particular copy of the program through sale or through lease. In the case of personal computer software that distinction may not always be obvious.

If the disk of the program was sold to you so that you own it (as you own the copy of a book you buy), then under Section 117 of the 1976 Copyright Act you have two statutory rights. First, you have the right to make as many copies of the program as you need in order to use it or to store it for backup or archival purposes. You do not have the right to make and distribute extra copies of the original program to someone else any more than you have the right to photocopy *Moby Dick* and hand out copies. Second, you have the right to modify the program to make it appropriate for your use. But you don't have the right to distribute the modified version of the program—even though part of it is your own work.

When you put down your money for the disk at the computer store, thinking that you bought the software package, you may in fact have leased the disk for a one-time fee. How can you tell? If the disk of the program is leased, the license that comes with the disk (sometimes visible through the shrink-wrap) should make that distinction clear. (If it

May 1983 PERSONAL COMPUTING



---

**LAW**


---

doesn't, in most retail situations you probably have a purchase.) The license accompanying a leased copy is a contract which spells out the rights you have. To ensure its enforceability, some manufacturers require that a prospective user sign and return a copy of the license agreement before the company will deliver a fully executable version of the software. Usually the license terms for a leased disk are more restrictive than the ones governing owned copies under copyright law. The basic principle with licenses is that unless the license says you may do something, you may not do it. Unless the license gives you explicit permission, you may not copy the program. You may not modify it in any way. You certainly can't make copies and distribute them. There is a concept of "fair use" in the Copyright Act covering how much use you may make of someone else's literary material for your own purposes, but personal computers are so new that it is not clear how fair use applies to computer software.

Assuming you bought the disk, or that the license agreement permits you to modify the program for your own use, one common question is how much do you have to modify a program before it's yours? The answer is you can't modify it enough to make it yours. If you add new ideas, logic, coherence and design while retaining parts of the original program code, it's not clear what the resultant work is. It's probably two works: your adaptations and the author's original. In that case, if either of you wants to distribute the modified program, you have to get licenses from each other.

### ***When infringements are pursued***

The typical home user doesn't really care about all these legal points. He's going to copy or modify a program because he needs to. So is the average computer user in an office. The single biggest threat to the distributors of computer programs is the copying that goes on in the commercial con-

text. About 85 percent of micro-computer sales are to Fortune 500 companies and professionals, making business users the biggest segment of the market. In the office environment the employer is often the purchaser and copies are routinely made for the benefit of fellow employees.

In order to pursue an infringement, the author or manufacturer has to find out that a violation has occurred. That may seem obvious, but discovery isn't always easy. The individual user in the home or office is often immune from prosecution simply because it's impossible for the manufacturer to police every individual personal computer user in the country. There are instances where manufacturers have pursued computer clubs for wholesale copying. Microsoft's reported action against the Home Brew Computer Club on the San Francisco peninsula in 1976 is one example. And there are many stories of manufacturers' representatives making unannounced visits to computer clubs to warn members against copyright violations.

Software manufacturers rarely sue a commercial customer who buys in large volume and whom they'd like to keep. So they don't often pursue a violator if they think a lawsuit will put a damper on future relations. More often they go after the professional pirate who is making and distributing black market software. They also tend to pursue an employee who goes out the door with the tape trailing from his pocket and sets up a competing business, or the bitter rival down the street who tried to steal their secrets. There are cases of customer-competitor lawsuits in which a user licensed a program, made some modifications and thought he had his own program, and then went into business in competition with the original manufacturer.

Finally, it has to be worth it to the prosecuting party to pursue charges. If the cost of a lawsuit threatens to

outweigh the money to be gained by bringing suit, the manufacturer will probably drop the charges.

### ***Penalties for infringement***

The copyright owner is entitled to actual damages. In the case of a \$200 computer program, it's difficult to specify what those damages would be. One form of damages might be the purchase price that wasn't received for the lost sales. But actual damages are complicated and difficult to show, so the 1976 Copyright Act also provides for so-called statutory damages that can be invoked instead. The statutory damages are not less than \$250 and not more than \$10,000 per infringement. The amounts vary with the number of works infringed upon, but not with the number of pirate copies generated at any one time.

In addition, the manufacturer can seek an injunction against the violator and impoundment of the infringing copies. Injunctions are typically what people use copyright law for, and they are a very powerful deterrent. If the case goes to trial, the lawsuit can run for years. Even before the case comes up, one alternative available to litigants is the temporary restraining order or preliminary injunction. The certificate of copyright registration is *prima facie* evidence of the rights assigned under the Copyright Act: "Here, your honor, I am the owner of the copyright of this particular work, and this guy's made copies of it. They weren't authorized copies. Make him stop." Often that is enough to get the copyright owner a preliminary injunction. If that preliminary injunction is granted, in most circumstances the case is over right there. Basically the defendant is out of business, with an enormous incentive to settle.

Finally, there are criminal penalties for copyright infringement. Fines of up to \$10,000 or one year's imprisonment, or both, are possible punishments for willful infringement

---



---

**LAW**


---



---

"for purposes of commercial advantage or private financial gain." Because it's such a headache to bring suit against individuals in the home or office, manufacturers try to discourage casual illegitimate copying by coding programs so as to make copying difficult (which has, by the way, given rise to a whole new industry of nibble copiers to defeat those codes). Manufacturers also structure their support to deny service to those with black market copies. Often the most important thing to a private user is his ongoing relationship with the manufacturer. He relies on this for updates, modifications, follow-on products, help with problems and

questions, and essential long-term maintenance. If, for example, you try to call some software companies for help, the first thing they want to know before they talk to you is the serial number of your particular copy of the program. Sometimes this is honored more in the breach than in the observance, but the serialization process does give the manufacturer the power to exclude you from the support that is critical to you.

---

***Rule of thumb***


---

In general, if you make copies or modifications for archival purposes or for your own use alone, you're not violating copyright law, and you may


not be violating a license. But once you hand a copy of either the unaltered or the modified work to someone else while retaining the original or a copy for yourself, chances are excellent that you have infringed on someone else's copyright.

---

*If you have legal questions regarding personal computing and the law that you would like to see discussed in future columns, address them to:*

*Trudy E. Bell, Associate Editor  
Personal Computing*

*50 Essex Street  
Rochelle Park, N.J. 07662*

*Sorry, we cannot personally answer or acknowledge questions.* 



*See what free software  
you can snare for little more  
than your time and phone costs.*

# Free Software: Is It Any Good?

There are some powerful programs that are yours  
for the asking—if you know who to ask

*by James E. Fawcette, Executive Editor*

If you're as skeptical as I am, you probably think free software is worth exactly what you pay for it. After all, if getting powerful applications programs or clever computer games were as easy as logging onto a public computer bulletin board or exchanging disks with friends at a local user's group, how could vendors get away with selling programs for hundreds of dollars a copy?

The answer is straightforward: Although there are authors who offer valuable software free to any user, finding these programs and figuring out how to use them is a challenge not everyone is willing to face. But if you truly enjoy using—and experimenting with—your computer, searching for these few diamonds in the rough can be a rewarding experience. It's an excellent way to learn about personal computing, particularly how to use telecommunications facilities—and, as an extra bonus, you may turn up some good software in the process.

Sometimes the independent programmers who write free software are bit-freaks for whom programming is an all-consuming hobby, but often they're businessmen who began using computers at work and became proficient at writing their own applications programs. These amateur software authors may then offer their programs to the general public to show off their achievement, to share their accomplishment with their

peers, or to genuinely help other people solve a common problem. Often, programs of widespread interest are not only widely adopted, but go through a series of refinements as users add their own revisions, find and debug problems, or expand the program's capabilities.

As a result, some free programs have been thoroughly tested by thousands of users, and checked and rewritten by dozens of skilled programmers. But finding these gems can be difficult, since they're hidden among literally thousands of free programs, most of which are utilities written to solve extremely narrow, specific problems, or systems programs of interest only to serious programmers. None come with guarantees. (But then, what software does?) Few have any kind of documentation, and the only kind of support you'll find is from other users.

If you're enthusiastic enough about personal computing to be willing to tackle these hurdles, then let's take a look at some ways to search for useful free software, and give you a sample of a well-traveled public program.

Many free programs are widely circulated among user's groups, simply through exchanging floppy disks. You can find specific user's groups for each major brand of computer in most parts of the country. Try asking the salesman at your com-

puter store. But if you don't have the time or inclination to become involved in these groups, you can still enter the world of free software as easily as dialing up a computer bulletin board. Literally hundreds of these services have sprung up across the country. In essence, they are a form of electronic mail, allowing users to leave or retrieve messages from the computer-equivalent of a post office box. Creators of free software can leave their programs in these electronic mailboxes for anyone to use. To access a bulletin board, all you'll need in addition to your computer is a modem, communications software, and a telephone line. The more capable your system is, however, the easier it will be to download files. If large files are needed or extensive on-line time is anticipated, a powerful system with large memory, say 256k or more, a 1200-baud modem, and a software buffer is desirable, though not essential. Most users tap into public software with machines ranging from Ataris to Apple IIs.

Bulletin boards range from widely-used commercial services such as CompuServe to small networks supported by local groups of enthusiasts. A list of 400 bulletin boards for Apple, IBM, Atari, Radio Shack, and other personal computers can be obtained by calling the People's Message System (Santec, Calif.) at (619) 561-7277. CompuServe already lists

January 1984 PERSONAL COMPUTING

## Are any of these programs truly useful? "Absolutely."

free software for the Radio Shack Model 100 lap-size computer, written by a special interest group.

Log onto one of these services and you'll see for yourself what you can snare for little more than your time and phone costs. For instance, by dialing up P-Chicago, a new bulletin-board service, you can find Chess (a computer chess game, obviously), Chasm, a Macro Assembler for MS-DOS programming, and PC-Talk III, a popular communications program for the IBM Personal Computer. (PC-Talk's writers ask for a modest \$35 donation.)

### Getting our toes wet

But are any of these programs really useful? "Absolutely," says Woody Liswood, a senior compensation and benefits consultant with A.S. Hansen, Inc., a Larkspur, Calif., consultant group—and an enthusiastic computer user. "Often, they're better than their commercial counterparts. I regularly use a number of public domain programs in my work," he says. "Every CP/M user should have a copy of either Wash or Sweep 38, a pair of disk managers, for example. There are many other good programs for accounting, statistical analysis and curve fitting."

With Liswood's help, we dug up a copy of a public domain program to try out the concept of using free software, with interesting results. Liswood gave us a copy of Regression Analysis, written by a programmer named Ronald Kennedy. We received a disk with no documentation other than a handwritten label that said, "Try running Hello and Hello2." This might be opaque, and perhaps intimidating, to novice users. But we were brave enough to simply slip the disk in the computer's drive. The program booted just fine. After the disk spun a bit, a pretty, graphic image came up, framing the words "Apple II Computers," and below it "Y=f(x) Regression Analysis by

Ronald Kennedy—Press space bar to begin."

With no manual to guide us, we pushed on bravely. After we pressed the space bar, the program's main menu appeared:

Y = f ( x ) REGRESSION ANALYSIS

1. ENTER/CHANGE DATA  
2. ENTER DATA FROM DISK  
0 DATA ENTRIES NOW IN MEMORY

TYPE NUMBER OF CHOICE,  
THEN PRESS RETURN KEY  
NOTE: THE PRINTER ROUTINES USED IN THIS PROGRAM ARE DESIGNED FOR USE WITH THE GRAPPER BOARD AND THE EPSON PRINTER

The typo was a bit disconcerting (Orange Micro's graphic board is the *grappler*, not grapper). But looking at the menu page was even more troubling. Menu entries 3 to 7 were missing. Where were they? Another worrisome question was whether we could get any kind of printout, since we lacked the specified hardware.

There was no need to worry. As we worked with the program—simply following the menu—the missing menu elements appeared as needed, and we got printouts of all the graphic images. The missing entries all pertained to manipulations of data, which were irrelevant until user information had been typed or loaded into the program. After we chose "2. ENTER DATA FROM DISK," we promptly got a catalog of the disk contents, and chose some data files Liswood had kindly included for us to fiddle with.


Regression analysis deals with data that can be plotted against X-Y coordinates. It provides various algorithms (procedures) for creating graphic curves that best fit and express the data. Our program allowed us to plot the data points, then calculate and graph four different types of curves, each using a different equa-

tion to represent the relationship between the four variables: linear, exponential, logarithmic, and power curve fit.

Inspection of each curve usually makes it obvious which one best expresses the data. Our free program made good use of color, plotting the curves in green, purple, orange, and blue, making it easy to compare the curves when all four are overlaid on one graph. Distinguishing their plots on a monochrome monitor is more difficult, however, but this isn't a substantial problem since each can be displayed separately. After running through the other menu-driven prompts, we were able to select the appropriate curve-fitting scheme, define the X and Y coordinate ranges, print out the equations and X, Y values, and plot the graphs.

Our experience with Regression Analysis was encouraging. It's a good example of public domain software—it's easy to use, does the job it's supposed to and does it well. Plus, you can't beat the price.

Sample some of the hundreds of computer bulletin boards yourself and try to find a few sparkling gems bobbing in the flotsam and jetsam of free software.

And while you're capturing these treasures on disk, your search will be valuable as an end in itself. Seeing first-hand, not in a manual, what other users have been able to accomplish on their computers can be an eye-opening introduction to the art of personal computing. And there isn't a better way to experience the power of telecommunicating by computer than by tapping into a few electronic bulletin boards and mail services and seeing what's available. Free software is worth the price—and more. 



## Choosing What's Best For Your Purposes

# The Family Tree Of Computer Languages

BY BERNARD COLE

To update an old saw, English is for talking to gentlemen, French is for talking to women, German is for talking to engineers, and BASIC is for talking to Apples. But what about all those other computer languages? Are they secret

tongues of exclusive programming societies? A few minutes of reading personal computer literature will prove that languages such as Pascal, FORTRAN, COBOL, C, and FORTH are alive and well in the world of microcomputers. But how does the uninitiated user unravel the pros and cons of all these options? In this introductory article we'll try to help by presenting some guidelines for understanding computer languages. Then we'll do a little genealogical work, tracing the development of five of today's major languages and six of the less common cybernetic tongues. With this background, you'll be ready for the more detailed descriptions of individual languages beginning on page 90.

### Divide and Conquer

To make sense of the 200 or more distinct computer languages, it helps to begin by broadly categorizing them as low-level or high-level, general- or special-purpose, procedural or problem-oriented, compiled or interpreted, structured or unstructured, and interactive or noninteractive.

Naturally, no computer language can be pigeonholed as neatly as these categories suggest—most actually fall at some point along the ranges defined by those ex-

tremes. Nonetheless, this approach should yield a valuable overview of both the individual languages as well as their relationships to one another.

**Low-level versus high-level:** Low-level languages give programmers direct control over details of computer hardware such as memory locations, microprocessor registers, and input/output ports. High-level languages distance programmers from these details, forcing them instead to work with abstractions such as files, arrays, and variables. The lowest level is machine language, and the highest level (at least in theory) is a "natural language" like English.

To appreciate the benefits and drawbacks of a low-level language take a look at machine language, the most fundamental way of communicating with a computer. It consists of a microprocessor's instructions represented in binary form as on-off patterns of micro-electronic switches. Assembly language is one step higher than this level; it uses alphabetic abbreviations for instructions and symbolic names for memory circuits and data. Compare a machine-language command (00100001 10001111 00001000) with an assembly-

language command (LD HL, MEMLOC) and its meaning (load register HL with the value of the variable MEMLOC). Programmers can work more accurately and efficiently in assembly language than in machine language; an assembler program translates their assembly-language code into machine language.

Machine or assembly language provides almost total flexibility in tapping a computer's capabilities. For example, a section of program code may be treated as data or vice versa, and program code can even be modified while a program is running. Machine-language programs can harness the specific strengths of a particular microprocessor and its input/output facilities. In applications such as systems software (operating systems and the like), this level of efficiency and flexibility is mandatory.

On the negative side, low-level languages require a great deal of technical knowledge and attention to detail, creating potential stumbling blocks for beginning programmers. Even professional programmers find assembly-language programming slow work compared to programming in high-level languages.

**H**igh-level languages, in contrast, take care of the hardware details automatically and allow the programmer to think in terms of the application at hand. The single BASIC command PRINT USING "###.##"; I/100 might replace scores of machine-level instructions. However, with this convenience comes an inevitable loss of efficiency and flexibility. Few high-level programs can attain the speedy performance of machine-language code. A few languages such as C and FORTH offer some of the efficiency of machine language together with the power of high-level languages. However, these languages are not well suited to the beginning programmer.

**General- versus special-purpose:** Most languages are created to serve specific purposes such as teaching programming concepts, controlling industrial robots, or creating graphics. However, many languages are extraordinarily flexible, and their ultimate uses far exceed the concrete plans of their designers.

General-purpose languages include BASIC, FORTRAN, COBOL (business data processing), LISP (list processing), and, more recently, ALGOL, Pascal, APL, and PL/I. The majority of programming applications have been written in BASIC, FORTRAN, or COBOL.

Special-purpose languages, on the other hand, enable programmers to solve narrowly defined problems or unusual applications such as systems programming, where one must be able to control the details of

the hardware. Special-purpose languages include C, FORTH, Modula-2, and Smalltalk—all for systems programming—PILOT for computer-aided instruction, and PROLOG for logic programming.

**Procedural versus problem-oriented:** Procedural programming languages require the user to specify a set of operations to be performed in a specific sequence. Unlike native machine and assembly languages that require instructions in a form very specific to a particular microprocessor, procedural languages are designed to be independent of particular machines. These languages relate to the procedures being coded, not to the specifics of the computer's architecture. A program written in a procedural language can be executed on any computer that has a translator for that programming language. Most of today's general-purpose languages are procedural.

**W**hile a procedural language specifies how something is to be accomplished, a problem-oriented language specifies what is to be accomplished. The closer the programmer can come to stating a problem without specifying the steps that must be taken to solve it, the more nonprocedural the language. Examples of such problem-oriented languages are program generators such as System 80, The Tool, Savvy, and The Last One.

Many professionals who program in procedural languages say that problem-oriented systems are not programming languages at all and that their use does not qualify as true programming. But according to James Martin, author of *Applications Development Without Programmers* (Prentice-Hall, 1982), and other experts who have studied the issue, the net effect of problem-oriented programming is exactly the same as any other sort of programming. Just as high-level procedural languages were developed to relieve programmers of the burdens of dealing with machine-level coding, problem-oriented languages make it unnecessary for the user to get involved in specifying the programming steps that must be taken to solve a problem. Moreover, just as procedural languages generate object code written in the computer's machine language, so problem-oriented systems now available for personal computers generate programs written in a particular symbolic code, whether assembly or procedural.

**Interpreted versus compiled languages:** On the most basic level of hardware, a computer can execute only instructions written in its native machine code. This means that a program written in a high-level language must be translated into machine code before it



will run. Two types of high-level language translators can do this: compilers and interpreters. A compiler performs the translation in two steps. It first translates the whole program into machine language, and then the machine-language version is executed by the computer. An interpreter performs the operations contained in the program as it reads them line by line, using a built-in dictionary that gives machine-language equivalents of high-level commands.

While the interpreter must repeat the translation of a given statement every time it occurs—a rather inefficient process—the compiler can repeat the necessary statements without translating each time, a much faster process. The drawback of the compiler is that it makes it difficult to modify or alter statements within the program. Usually the entire program must be translated over again if changes are required. Thus for programs undergoing changes, revisions, or improvements, which is often the case for the inexperienced programmer, an interpreted language is better because it permits interaction with the program during execution and makes changes immediately.

Depending on the specific application, various programming languages tend more toward one approach than the other. COBOL and FORTRAN are usually compiled while APL is generally interpreted. Of the available BASIC translators, about half are compilers and half interpreters.

**Structured versus unstructured:** Here we're dealing not so much with characteristics of particular languages as we are with the qualities of programs themselves, whatever the language they're written in. Lately much discussion has focused on the pros and cons of structured programming, but all computer programs have *some* sort of structure. A more accurate distinction is between good (logical) structure and bad (illogical) structure.

**I**n the same way that it's relatively easy to learn the grammar and syntax of a foreign language like French or Spanish, it's not too difficult to master the basics of a particular programming language. What is not so easy is writing a program in a clear, logically organized manner.

According to Kenneth Orr, author of *Structured Systems Development* (Yourdon Press, 1977), a program is well structured if (1) its routines and subroutines are in a modular form in which each module is a program segment containing a complete, logical thought; (2) its modules are hierarchically organized in such a way that within each module there are nested logical subunits that are themselves structured and contain further subunits; and (3) it uses straightforward, readable code rather than slightly more efficient but obscure code.

**A** well-structured program has at least four advantages. It is easier to debug during development because the logical connections between various instructions, routines, and subroutines can be clearly seen; it is more likely to be correct the first time around because of the care that went into its design; it usually takes less time to create because it has fewer bugs to find and fix; and it is far easier to *maintain*, that is, to update or correct at a later date.

Most programming languages allow you to design well-structured programs, and numerous books explain how to do it. But what many programming languages (especially the older ones) also allow is the design of poorly structured programs. Only the newer computer languages such as Pascal and recent revisions of older languages such as SBASIC actually *prevent* you from using procedures that lead to illogical program structures. Many of the problem-oriented program generation languages require that you enter information about your application in a logically structured way.

**Interactive versus noninteractive:** As with structured programming, the advantages here all lie on the side of interactive languages. Surprisingly, though, of the traditional general-purpose procedural languages only APL and BASIC were designed from the start for interactive operation. Moreover, Logo, PILOT, and Smalltalk are the only members of the newer generation of languages that may be characterized as truly interactive.

In an interactive language you can communicate directly with the computer both when you're typing in the program and when you're running it. In addition to faster response time, here are a couple of other advantages that would lead one to choose an interactive language:

- **Interactive editing:** The process of developing a program alternates between running the program and changing or editing to correct the errors the preliminary runs turn up. While noninteractive languages separate the editor and the translator, the interactive program integrates the two, eliminating a number of time-consuming intermediate steps.

- **Immediate error detection:** If you type an incorrect line, a good interactive language will report it immediately. You can then correct the error while the purpose of the line is still in your mind. If the error was due to a misconception that you corrected, you also avoid repeating the error on subsequent lines. Noninteractive programs support the detection and subsequent correction of errors only after the entire program has been typed in.

## A Brief Survey

Each programming language, of course, does not fit neatly into one or another of the broad types we've defined. Most languages fall into more than one of the categories. This is particularly true of the more recently developed programming languages, and the categories are likely to get fuzzier in the future. As the following chronological survey of widely used programming languages indicates, the newer languages tend to be on higher levels of abstraction, less procedure-oriented, more multipurpose, more natural and English-like in their syntax, and more structured than the older languages.

**FORTRAN (1956):** Initially developed for solving problems in mathematics, engineering, and science, FORTRAN has found its way into such areas as business and education because of its popularity as a teaching tool in colleges and universities. Almost always compiled, its grammar, symbols, rules, and syntax are

Bernard Cole is a freelance writer living in Berkeley, California.



similar to mathematical and English-language conventions. FORTRAN treats arithmetic operations with commands that evaluate expressions and substitute the results for current values of variables. String manipulation in FORTRAN is difficult but not impossible.

Graphics-processing programs, database management systems, and word-processing programs all have been written in the language.

**COBOL (1960):** Developed specifically for business and commercial applications, COBOL is characterized by programs stated in precise, easily learned natural words and phrases that can be read by nontechnical users. The language offers many important file-organizing features and can deal with variable data lengths. Input/output procedures and report generation are its strong points.

**ALGOL (1960):** A particularly powerful language, ALGOL was originally developed as a general-purpose language for expressing formal problem-solving procedures known as algorithms. Although similar to FORTRAN, it is more comprehensive and flexible. Also, thanks to its more formal structure it poses fewer exceptions and is more readable.

**LISP (1960):** Featuring impressive list-processing capabilities, LISP is the choice of researchers in artificial intelligence. The language is designed specifically for the manipulation of nonnumeric data that often changes considerably in length and structure during the course of a computer run. Because LISP defines a list simply as a set of items given a specific order, it offers a convenient way of representing such data as English sentences, mathematical formulas, positions in a game, logic theorems, or computer programs. This capability makes the language a powerful tool in applications such as the generation and verification of mathematical proofs, pattern recognition, algebraic manipulation, simulations of human problem solving, information retrieval, heuristic programming, linguistic analysis, computerized translation of numerical languages, and explorations of new non-procedural programming languages.

**BASIC (1964):** Incorporating features of both FORTRAN and ALGOL, this language was designed to be very simple to learn and inexpensive to implement and use. From the start it has been an interactive language; the user gets an immediate response to what is typed into the computer. Its major advantage to beginning programmers is that it is available in both

**I**nnovative languages were part of computing's New Frontier in the early '60s, when COBOL, LISP, and BASIC were developed.

interpreted and compiled versions. In an interpreted version, anyone can write a program and then inspect, modify, and correct it with a minimum of inconvenience. Microcomputer versions of BASIC have increased in power to the point that today they are more than

adequate for a large number of business and commercial applications.

**PL/I (1964):** Designed as a multipurpose programming language for solving both business and scientific problems, PL/I incorporates features of both FORTRAN and COBOL. On the FORTRAN side PL/I has simple, concise statements, but like COBOL it has the ability to manipulate and input or output grouped records or files quite easily. It uses basic building blocks called procedures, which are blocks of instructions designed to perform stated functions. One procedure can be hierarchically incorporated into another, and any data declared in a procedure is automatically available to all procedures nested within. PL/I can handle strings of alphanumeric characters or strings of bits. It also allows programmers to describe data in terms of arrays and other sophisticated "pointer" structures.

**APL (1967):** Among the general-purpose procedural languages available for personal computers, APL has the most comprehensive set of primitive operators to carry out such functions as random-number generation, index generation, factorial computation, and matrix formation and inversion. A very powerful language with operators that carry out actions requiring dozens of statements in other languages, APL is very popular among statisticians due to the speed with which algorithms can be developed and tested. But APL is not limited to numeric applications; it is used in a wide range of business applications such as document production, graphic analysis, data retrieval, and financial analysis. The main reason for this is that APL was designed to be a highly interactive, conversational language. Thus even a beginner can do meaningful work within minutes and still have a language of great power and range.

**Pascal (1971):** Designers of Pascal wanted to create a language that encourages (some would say demands) structured programming. With a syntax similar to ALGOL's, Pascal is a "small" language in that it does not allow a large number of different syntactic constructs (unlike PL/I, for example). Pascal is intended to be easy for programmers to learn and retain.



# M

any of the noteworthy languages created in the 1970s—especially FORTH and C—were designed with systems programming in mind.

**Smalltalk (1972):** Conceived as a tool kit that would enable students and teachers to explore a subject or solve a problem, Smalltalk uses a wide range of graphic "objects." As little as a year ago Smalltalk could be considered a special-purpose language used almost exclusively in the

academic research world, but now that a number of business-oriented computer manufacturers (including Apple) and software designers (such as Visicorp) have used it in their newest products, it could well be on its way to a place in the mainstream of general-purpose applications languages.

**PILOT (1973):** Originally designed to introduce children to the fundamentals of computer performance, PILOT is now most often used in writing programs for computer-aided instruction in all subjects. It is especially tailored for such instructional tasks as drills, tests, and dialogues and allows convenient comparisons between words or portions of words. PILOT is not a good choice for complex computational problems.

**C (1974):** A structured programming language that lends itself to systems programming as well as to more mundane programming tasks, C produces code that approaches machine language in density and efficiency while still offering some high-level language features such as structured programming and systems programming capability. A C compiler is simple, compact, and easily written—a professional programmer using current technology can prepare such a compiler for a new machine in no more than a few months. Because C is independent of any particular machine's architecture, it is suitable for writing portable programs.

**FORTH (1975):** Like C, FORTH is a kind of a high-level assembly language designed for systems programming. FORTH is unusual in that it offers many interesting features not normally associated with interpreted languages, such as allowing you to add new commands. It maintains a system library of command calls that is actually a list of addresses of routines that execute the commands. You can use any of the existing library commands to build up more complicated ones.

FORTH is not as fast as assembly language, but it's much faster than interpreted BASIC. Its special features allow you to customize the language for a specific application. By defining new special-purpose commands and adding them to the library, you can make

FORTH into a language that conveniently meets your particular needs. For example, if a statistical language is required, the necessary functions can be added to the library and subsequently used as new commands. Similarly, the library could be easily customized for sophisticated

electronic filing or complex financial calculations.

### What the Future Holds

It is clear that over the short term traditional procedural languages will continue to dominate in most personal computer applications. Experts expect that such languages will continue to evolve and that major new languages will be introduced occasionally.

Despite the enormous increase in the number of personal and small-business computers, development of programming languages will be much slower than in the past. This is because the rapid proliferation of personal computers has drastically changed the environment in which programming languages are developed. On the one hand, software companies that find themselves unable to produce enough canned programs to satisfy the demands of all the new users of computers are looking for ways to increase the productivity of their professional programmers. On the other hand, though, many personal computer users want to write their own programs but have neither the time nor the inclination to learn a procedural dialect.

According to the experts, these demands will favor greater development of nonprocedural program generation languages. Such software packages are now becoming available for use on personal computers. A good example is The Last One, which generates BASIC source code.

One drawback (if it can be called that) of these first-generation program generators is that they relieve you of the coding only. You still have to go through the process of developing the overall design of the program. Indeed, such nonprocedural program generators literally force the user into designing a structured program. As such, they are not for the old-school, seat-of-the-pants professional programmer or for the novice programmer who is unfamiliar with structured programming. Artificial intelligence research centers and software companies are working on "expert systems" that not only relieve you of the coding but also help you structure programs. We can expect such expert systems to hit the market within a few years. □

# C O L U M N      D E B U T

## THE PROCESSED WORD

by Terry Tinsley  
Datz and  
F. Lloyd Datz

Welcome to "The Processed Word," a new column devoted to word processing on the pc and XT. In the coming months we'll review word processing programs and such related software as spelling and grammar checkers. We'll emphasize new and innovative programs of special interest, including VisiCorp's *VisiWord*, Bruce & James's *Word-Vision*, *PFS:Write*, *MultiMate*, *WordPerfect*, and the new entry from NBI, a manufacturer of dedicated word processors.

But we'll start by surveying the various features word processing programs may offer and defining some of the terms we'll be using later on. This column will be very general and elementary; if you're altogether new to word processing and haven't yet decided which program to use, you may find this installment a handy reference of features to consider when shopping for a program.

### Overall Program Design

*Menu-driven versus Command-driven Software.* The overall organization of a word processing program is what determines how user-friendly it is. Menu-driven software lists all command choices on the screen, displaying more specific menus as general choices are made. In contrast, command-driven software provides no menus and only minimal prompts; consequently users must be familiar with all the commands. Most people find menu-driven programs easier to learn.

But the choice between menu- and command-driven software is not as obvious as it might seem. The helpful menus and prompts that make software so easy to learn also make it run considerably slower. Once you're familiar with most of your word processor's commands, you'll want to get the job done as quickly as possible without stopping to respond to screen messages or wait for a succession of menus to appear. Fortunately, some programs allow you to adjust the level of help to your particular needs.

This means that all the menus and prompts are available to help you learn the program, and then as you become more proficient, you can turn off the prompts to speed the program up and leave more of the screen free for text display.

*Mode.* Another fundamental difference in the way word processing programs are organized has to do with modality. Programs that require you to make extensive mode changes are like cars with manual transmissions: You must keep them in the correct "gear" by entering and exiting the appropriate modes. For example, if you are typing along and then decide to go back and delete a few words, you have to shift out of insert mode and into delete mode, erase the unwanted words, shift out of delete, and go back into insert to continue typing.

Each program handles mode changes differently. Some automatically return to insert when you exit another mode, while others return to a "neutral gear" between mode changes. Many require mode changes for certain features but allow you to access others directly. Programs that keep mode changes to a minimum are, for obvious reasons, less awkward to use.

### Text Entry and Editing Features

*The Editing Screen.* Most word processors display a status line at the top of the screen to provide you with such information as the name of the document in memory, the command currently being executed, the page, line, and column position of the cursor, the line spacing, and the current mode. In addition, there may be a "ruler" that indicates the settings for tab stops and left and right margins. A new trend, however, is to display fewer elements on-screen; this leaves the editing screen free of clutter.

*Word Wrap.* This standard word processing feature functions as an automatic carriage return. Instead of looking up at the end of each line to decide where to place the car-

Terry Tinsley Datz is a freelance writer and F. Lloyd Datz is a faculty member at the University of Utah Medical School. They have recently completed a book on word processing for the IBM pc.



riage return you just keep typing, letting the computer decide where to end the line. When typing extends past the right margin, any words that won't fit on that line are automatically moved down to the left margin of the next line. This feature is a real timesaver, but it may be a while before you quit reaching for the return key when you near the end of a line.

On some occasions you'll need to control line breaks more precisely. Most, but not all, word processors allow you to turn off word wrap when you're typing highly formatted text, such as tables, forms, addresses, or programs.

**Cursor Movement.** When you generate text on a typewriter, the words originate where the typing element strikes the paper. On a word processor, text originates at the cursor position, which is usually indicated by a blinking line or square. Since entering or editing text requires that you first move the cursor to the desired location, cursor movement commands are the most frequently used editing commands.

The best word processors give you a variety of ways to manipulate the cursor. In addition to horizontal movement by character and vertical movement by line, most programs give you the option to move by the word, sentence, or paragraph; to the left or right margin; to the top or bottom of the screen; or to the beginning or end of the manuscript.

The trend in word processing programs is to allow you more and more flexibility in cursor movement. For example, most programs now allow you to jump to a specific page or character. This means, for example, that you can quickly add an entry to a resume by moving the cursor directly to the desired page number instead of having to browse through several pages until you find the page you need. Programs that won't jump to a specific page number sometimes permit you to place markers at strategic locations to which you may want to return later.

**Scrolling.** Scrolling allows you to review a document by scrolling the text up or down as if it were one continuous piece of paper. Many programs allow you to vary the scrolling speed, so you can slowly scrutinize the text for errors or quickly scan it to find a particular passage. Some word processors are capable of extensive horizontal scrolling; this is a big help when you're working with oversized documents, such as those used in accounting. If you routinely work with wide documents, look for a word processor that can horizontally scroll at least 132 columns. *WordStar*, the all-time champion of horizontal scrolling, goes far beyond the call of duty to scroll 32,000 columns!

**Insertion and Deletion.** To add text to a document you insert it at the position of the cursor. To prevent what has already been

typed from being written over, text in front of the cursor is pushed forward as you enter the new words. If you're a fast typist, you might be able to enter text faster than it can be pushed forward. Therefore, some programs have a type-ahead buffer that acts like a scratch pad, saving any text entered too rapidly to be displayed. When you pause, the computer catches up, inserting the text it has stored. If the buffer fills up, a message is displayed asking you to wait a few seconds for it to empty.

Other programs split the text at the point of insertion and move everything in front of the cursor off the screen entirely. Although this approach prevents you from losing keystrokes, not being able to see the remainder of the sentence you're editing can be disconcerting.

When insertion mode is turned off, new text is typed over the characters under the cursor. Overstrike mode is useful for correcting typographical errors.

**Deletion.** While all word processors let you delete one character at a time, most also allow you to delete larger amounts of text—such as a word, a portion of a line, a screenful, or an entire document—by means of one or two keystrokes. Because deleting is so simple, you have to be careful not to erase text accidentally. Programs that automatically save deletions in a buffer graciously give you the opportunity to recover from such accidents.

**Cut and Paste.** What makes word processing such a powerful tool is the ability it gives you to rearrange sentences, paragraphs, and full pages of text with the press of a few keys. Changes that would normally require you to retype an entire manuscript can be accomplished in seconds.

Before you can manipulate a block of text, you have to mark the beginning and end of the passage. Then you can move the block, copy it to a second part of the document, or delete it. With some programs, block operations can be performed between two different files, so that text can be transferred from one document to another. The size limit for block operations is a function of both the word processing software and the memory capacity of the computer.

**Search and Replace.** Suppose you have a file containing several chapters of a book and you decide to edit Chapter 6. Instead of scrolling through the text until you find the chapter heading, you can use the search or find command, telling the computer to locate the heading "Chapter 6" and bring that portion of the book to the screen.

The search function can also be used to locate every occurrence of a word or phrase. Keep in mind, however, that the computer is literal to a fault: If you ask it to find all occurrences of the word *he*, the letters "he" will be found even if they are part of another

word. Some programs give you the option of circumventing this problem by marking the word only if it appears as a whole word (enclosed by spaces or punctuation). Capitalization can also cause problems. A word processor should be able to ignore case, if you wish, so that it will find both "computer" and "Computer" in response to the same command.

Related to search is a very important function called *replace*. Once a word or phrase has been searched for, *replace* lets you automatically exchange it for a different expression. In addition to doing a global replacement, some word processors will also replace the specified word or phrase only the first *x* number of times it appears or will show each occurrence to you in context and ask your permission to replace it. The ability to discriminate whole words is even more important with global *replace* than it is with global *search*. Without that capability, if you changed *man* to *person*, you would also, for example, change all occurrences of *manipulate* to *personipulate*.

The search and replace commands have a variety of uses. Form letters, contracts, or other documents with standard wording can be modified and used again and again, never losing their personal touch. Also, you can reduce typing time and errors by entering a symbol like "\*" for lengthy or hard-to-type phrases. For example, when typing the manuscript for "2010: *Odyssey Two*," Arthur C. Clarke could have typed "\*" every time he referred to Sivasubramanian Chandasegarampillai, the creator of the computer HAL. Then he could have used the global search and replace command to change every occurrence of "\*" to the untypeable name, thereby saving himself considerable time and effort.

**Columns.** Arranging text or numbers in columns does not come easily to most word processors. As a result, programs vary significantly in their column-handling capability. Unfortunately, some do not recognize columns as independent portions of text. This means that any changes you make in one column will affect other columns that you have set up, thus destroying your carefully planned (and laboriously achieved) format. In short, if you frequently use columns or tables in your documents, look for a program that has a specific mode to handle them.

Some word processors that can work with columns go a step further to perform simple mathematical calculations, such as adding, subtracting, multiplying, and dividing across columns or generating subtotals, totals, and grand totals down columns.

**Split-Screen Editing.** Sometimes also called *windowing*, this feature enables you to view different parts of the same document or portions of two or more separate documents



at the same time. In this way you can, for example, view the first draft of a manuscript in one window while you type the revision in the other. Although this feature is not a standard one, it is becoming more widely available. If you need windowing, look for a program that lets you scroll the text in either window regardless of which window the cursor is in. Having to move the cursor back and forth between windows each time you want to scroll just a few lines makes the windowing feature less efficient.

### Formatting and Printing

A word processor's formatting and printing capabilities allow you to control the layout of your document. The best programs use on-screen text formatting, displaying the text exactly as it will appear on the printed page. An alternative is the use of nonprinting embedded commands to direct the printer to underline, right-justify, double-space, or perform numerous other formatting functions. In this case, the text appears on the screen unformatted, with the embedded commands scattered throughout. Many programs compromise between these two approaches, requiring embedded commands only for some of the more specialized features.

Not being able to see the final appearance of your document before printing makes it difficult to set up complex formats. Some programs will "print" to the screen first so that you can get a preview of what your document will look like on paper, but usually you have to get back into the editor to make any changes. Many users are satisfied with this approach and even prefer it, while others demand on-screen formatting.

**General Layout.** Text layout is controlled by means of a series of format settings. These are usually preset to commonly used default values, which can easily be changed. Some programs allow you to change the default values permanently; others require that they be reset each time you turn the computer on. A new trend is to store each document's settings on disk as part of the document file so that the format is ready to go whenever you work on that document.

Parameters commonly subject to format setting include the following: paper length, line height, pitch, line spacing, and tab stops.

Paper length is the total number of lines on a page, including top and bottom margins. Usually page length is set to sixty-six lines on a standard 8½ × 11-inch page.

Line height controls the vertical spacing of the text. It is usually stated as the number of lines per inch. A line height of six lines per inch is standard and compatible with a paper length of sixty-six lines per page.

Margins can be set just as they are on a typewriter. The top and bottom margins are the number of blank lines between the edge

of the paper and the text. The left margin setting depends on the pitch (see following paragraph) and is the number of blank columns from the left edge of the paper to the text. With pica type, ten columns represent a one-inch margin. The right margin is set by entering the number of columns per line. A standard setting is sixty-five.

Pitch refers to the number of characters per inch. The most commonly used pitches are pica (ten characters per inch) and elite (twelve characters per inch). Unlike typewriters, word processors allow you to vary the pitch without changing the print element (assuming you're using a dot-matrix printer). This means that you can change the pitch in the middle of a manuscript without interrupting the printout.

Line spacing can also be varied as needed. Although manuscripts are usually either single- or double-spaced, many programs also allow you to specify more generous spacing between lines.

Tabs are commonly preset to intervals of five columns. Most programs let you change these settings to any column, making it easy to format outlines and indented text. In addition, if decimal tabs are offered, numbers can be aligned automatically by their decimal points.

**Justification.** The feature that sets text created on a word processor apart from typewritten text is full or right justification. Fully justified text looks like it has been typeset, because the right margins are perfectly straight. A word processor accomplishes this by inserting just enough extra space between words to align the last word on each line precisely at the right margin.

Inserting extra spaces between words can produce unevenly spaced text with large gaps between some words. Microspace justification, also called incremental spacing, improves the appearance of fully justified text by inserting tiny spaces (about 1/120th of an inch) between both words and letters. This evens out the spaces, giving the text a more pleasing appearance.

**Proportional Spacing.** Ordinarily, both typewriters and word processors set aside the same amount of space for each letter. Proportional spacing can be used to produce a more professional, typeset look by assigning different widths to different characters. This means that an "i" takes up less than half the space of a "w" on the printed page. If you produce camera-ready material or if your documents must have a very professional appearance, be sure that both the word processing program and the printer that you purchase can achieve proportional spacing.

**Automatic Page Numbering.** Most programs will print page numbers at the top or bottom of the page, either centered or at the left or right edge. If your documents are to

be bound, make sure that page numbers can be printed alternately at the left and right margins.

**Headers, Footers, and Footnotes.** A header is text that appears at the top of each page, prominently displaying such information as the name of a chapter or the title of a report. Footers, as the name implies, provide the same sort of information at the bottom of the page. Although many word processors automatically print specified headers and/or footers on each page, some programs limit them to a maximum of one line.

Footnotes present the formatter with a real challenge. The program must decide how much space to reserve at the bottom of the page, even though it doesn't know how long the footnotes will be or whether the writer will place an additional one just before the end of the page. Therefore, some programs do not even attempt to offer footnote capability. Programs that do support them vary as to how automatic the function is. The more powerful programs handle this problem beautifully, automatically numbering each footnote and moving it to the appropriate page when its referring text is moved. Be sure to check on length limitations; some programs set miserly limits, while others allow footnotes up to a page or more in length.

**Pagination.** Page breaks are usually indicated on-screen by means of a dashed line or other marker. This allows you to spot the inevitable first and last lines of paragraphs that are destined to be printed at the top or bottom of the page, isolated from the rest of the paragraph (these are often called orphans and widows, respectively). By adjusting the page breaks before you print your document, you can eliminate these unsightly creatures. Some programs automatically control orphans and widows by seeking out isolated lines and repositioning page breaks to eliminate them. A related feature allows you to set conditional page breaks to ensure that groups of lines which absolutely must stay on the same page (such as tables) do so.

**Hyphenation.** While some people feel that hyphenation is unnecessary and never use it, others are convinced that it is absolutely essential for creating attractive, fully justified text. If you routinely work with full justification, you will no doubt find that the extra spaces inserted to even out the margins make the words look too spread out unless some form of hyphenation is used.

Word processors handle hyphenation in various ways. A surprisingly large number ignore the problem altogether. Others allow you to insert ghost hyphens (also known as discretionary hyphens) at appropriate breaking points in long words; these word processors will then divide a word at the ghost hyphen, if the word falls at the end of a line. Another common approach is to show you



words that are likely candidates for hyphenation—those destined to be wrapped down to the next line because of insufficient space on the current line. Usually the program places the cursor at a suggested break point but allows you to overrule its choice before it inserts the hyphen. The hyphen inserted in this manner will not print if further editing moves the word away from the right margin. A few programs hyphenate automatically, dividing words into syllables according to a set of built-in rules. This approach often leads to grammatically incorrect breaks, because of the large number of words that are exceptions to the rules.

**Automatic Paragraph Reform.** During the editing process, paragraphs may take on a disorderly appearance as you insert, delete, and otherwise rearrange text. Normally, in order to prevent your getting a printout with some lines dangling past the right margin and others consisting of only one word, you must remember to reform each paragraph individually as you finish it. Some of the newer programs perform this task automatically so that you can edit to your heart's content without worrying about cleaning up the mess afterward. These programs follow behind you, reformatting each paragraph according to the margin and line-space settings you've selected.

**Special Printing Features.** Provided that your printer cooperates, many word processing programs allow you to create special printing effects, including some not possible on a typewriter. Underlining (underscoring) is supported by most word processing programs, as is double strike; the latter produces a darker, solid-appearing print by having the printer strike each character twice. Boldface print can also be generated by having the printer type each character twice, with the second impression slightly to one side of the first. This produces a very dark, thick print, suitable for titles, headings, and key words.

Strikeout is the superimposition of dashes over characters. It's sometimes used to indicate deleted text in a revised version of a manuscript; it's also commonly used in legal documents. Overprinting is similar to strikeout, except that any character can be printed over another, making it possible to generate accent marks over letters in foreign languages and to combine several characters to form a symbol not found on the print wheel. Many word processing programs also enable you to create superscripts and subscripts, provided that your printer can handle them.

Special-character printing is done by sending a code to the printer so that characters present on the print wheel but not on the keyboard can be printed. In addition, on printers with ribbon-color selection, ribbon shift causes marked text to be printed in an

alternate color, usually red.

### File Handling

**File Directory.** Most word processing programs begin by displaying a directory of the files stored on disk. This directory often contains several pieces of useful information about each document, such as its name, its length in pages or bytes, the author's or operator's initials, and the date the document was created or last edited. Information about the length of the file is especially useful, since it gives you an estimate of how much disk space is still available. Some programs keep a tally of the amount of space used by all the files on each disk and tell you how much free space remains on each. This helps you avoid creating documents larger than the available disk space.

**Ability To Save and Continue Editing.** If the power going to the computer is interrupted or your equipment bombs out on you, the document in memory can be lost. Therefore interrupting your writing frequently to save your work on disk is a very good idea. Programs allowing you to execute a save without leaving the editor encourage you to save your work more often. On the other hand, those programs that make file-saving difficult and time-consuming will tempt you to court disaster by not saving your document often enough.

**Automatic Backup.** Some programs automatically save the last version of a file each time you begin a new revision. Then, if disaster strikes, your original text will not be lost. Such automatic backup, however, is not a complete substitute for saving your work frequently.

**Automatic Disk Buffering.** The maximum-size document that can be edited is related to one of two factors, depending on the word processing program. Some programs load the entire document into RAM; with these programs, file size is limited only by system memory. Other programs are capable of automatic disk buffering; in these, document length is limited only by the available disk space. Automatic buffering systems write and read portions of your document to and from disk as you edit. If you jump to a remote part of the document, the program stores the portion you're working on and loads the new section into memory. Although this means that you can edit lengthy documents in their entirety, it also retards program operation, since the program must occasionally ask you to wait while it goes to disk.

The newest approach is to keep only one page of text in memory at a time. This means that as soon as you finish a page, it is automatically stored on disk, safe and sound in the event of unforeseen disaster and readily accessed by page number for future editing.

**Keyboard Macros.** Keyboard macros are

small segments of text, such as a standard closing for a business letter, that can be set up for quick insertion into documents. A collection of often-used phrases or sentences can be created and stored in a file; each of these phrases can then be assigned a specific key combination (such as control-A) or given a short name for identification. When you need one of the macros, you just press the appropriate key combination or enter its name, and the text is written to the screen almost instantly. Macros can also be used to make format changing quick and easy.

**Document Assembly.** The most powerful word processors allow you to put documents together with the help of various files that you've created and stored on disk previously. This file-merging process (sometimes called boilerplating) can be automated to help you create personalized letters from a mailing list or assemble several standard paragraphs to produce a final document, such as a contract or a will. Document-assembly capability varies widely among word processors; some require you to interface a second program with the basic word processor.

**Printer Control.** A word processing program's file handler usually gives you several options for controlling the printing process. A document can be printed one page at a time using single-sheet feed or a continuous feed if the paper is tractor-fed. Some programs also allow you to print multiple copies of the same document with a single command.

If your computer has adequate memory, background printing may be possible. Normally, when a document is being printed, the computer cannot be used until the printing is completed. Background printing frees a portion of the computer's memory so that you can edit one document while printing another. If you produce many long documents or if rapid throughput is important to you, you'll appreciate this feature.

Batch printing can also be used to save printing time. Programs that support this feature allow you to specify a list of documents to be printed; this list is sometimes called a print queue. The word processor automatically supervises the printing process, making as many copies of each document as you need. Since printing can be done without intervention, you're free to work on other projects.

**In Coming Months.** Next month we'll get down to business and start reviewing word processors available for the pc. First on the schedule are two programs from Satellite Software International: *WordPerfect* and its baby brother, *Personal WordPerfect*. ▲



# Assessing Your Data Management Needs

*Before buying any database management system, you should determine what your data management needs are and what kind of system is required to satisfy them. What kinds and quantity of data should be entered? How many ways do you need to access it? What types and how complex will the reports be that are drawn from it? Ed Sayle surveys the entire spectrum of data management to help you decide how elaborate and extensive—or how simple and limited—a system you may need.*

Perhaps the biggest obstacle a newcomer to data management must overcome is that of semantics. The confusion only begins with such terms as file, multifile, sequential, random access, ISAM, hierarchical, Codasyl, networking and relational. After observing countless demonstrations, the newcomer might gain confidence that finally the several types are understood, only to have a salesperson say, "It stores data in a hierarchical mode, but recovers it in a relational mode," or something equally as disruptive to the naive. A published review of a new database program might warn that although it is advertised as relational, the reviewer suspects it to be of the networking type. Each dealer visited has a recommendation, but with so many systems on the market the prospective buyer may be assured that the suggestions will be in conflict.

What it boils down to is the user's desire for a data management system that will collect the information s/he wants and retrieve it conveniently. Those in business might want mailing or customer lists, correspondence files, personnel records, inventory or accounting. In the professions the need might be for an appointments calendar, client files, bibliographic reference, research data manipulation, checkbook control or patient billing.

Software programs to perform such functions range from less than \$50 to \$1,000 or more. Obviously, there has to be a difference, and that rests with the intended use. Put another way, to deliver firewood, do you need a truck or a luxury sports car? Borrow from the jargon of database systems and address the problem "sequentially" before pulling out the checkbook:

- Do you need a data creation and management system?
- What data will you put into it?
- How many entries do you anticipate?

- How many ways will you want to be able to access the file?
- What type of reports will be drawn from the file and how complex must they be? Will you need elaborate forms or will simple listings suffice? Will the reports require calculation—averages, medians, and so forth?

If you have problems with any of these basics, the best advice is to go back to the drawing board. There are far too many options ahead which must be grounded in these factors.

## Level one

At the low end, for example, the need may be for a small filing system on a given topic, which will be used later for a single purpose. Your word processor may be more than adequate to create and maintain a research file. Once located, a desired item may be printed out or written to another file using those word processing commands with which you are already familiar. Similarly, most word processors will produce a mailing list and print address labels at a speed limited only by the capacity of the printer used. Also possible is rudimentary manipulation of the information—searching, sorting (name, zip and reference fields are the most common needs), and merging into specific fields of other documents, the so-called mail-merge function ("Among my many satisfied customers in Keokuk who purchased the 1980 Superblatt, Mr. Smith, you have been selected to receive this special trade-in offer").

Rereading your word processor manual may establish that the number of entries you will maintain, the ways you wish to access them, and how you desire them to be printed may already be at your disposal.

## Level two

Single-purpose files are the most com-

mon requirement in business and the professions. Hundreds of available business software packages address it, each offering advantages. The better mailing list programs, for example, include utilities for adding, changing, deleting, reordering, sorting and printing from easily understood menus (options). Other programs provide filing of correspondence by key words (subjects or topics) and recovery for review or printing of those meeting the criteria established by a key word search. A host of bibliographic or research summary programs offer a range of recovery and printing options. Some inventory programs maintain data sequentially, by indexed sequential access method (ISAM), or on a random access basis, again menu-driven, to document the addition or dispersing of items and extracting a list of those items that have reached or dropped below the reorder level.

What? The reader may have stumbled over this last one; the terms "sequential," "random access" and "ISAM" were introduced deliberately as a lead-in to another question: if the program does what you want it to do, does it really matter how it does it?

For now, the answer must be an obvious "no."

In sum, if a single file system meets all your requirements and is easy for you and your employees to master, settle on it with only one caveat: it is probably not configurable. This means that it will do what it is supposed to do, but probably cannot be adapted to serve different requirements which may arise in the future.

## Level three

But what if your data management needs require you to work with more than one type of data located in more than one file? The single-purpose software packages you have decided on in all probability will store their data in different



ways. This is no problem when the personnel files need not interact with inventory or other support files. You may, however, desire interaction between personnel files and payroll. Or you wish to mesh information from both inventory and invoices. In each case, the single-purpose packages in use may be incompatible.

More and more publishers of software have addressed the multifile problem, exercising methods both simple and complex. For the average user, the answer may be a consolidated file, one which holds all the information that might otherwise be held in separate files, and is at once compatible with all the operating programs one needs. This is the basis of the multifunction software packages now reaching the marketplace. Such software integrates all the operating pieces into a master program which will do word processing, spreadsheet, graphics and database management, working interactively with the same data. Multifunction offerings by Lotus, VisiCorp, MicroSoft, MicroPro and others may be all that are needed to address the multifile dilemma.

Other off-the-shelf multifile software programs work interactively. Sometimes the interaction is invisible to the user, but generally it requires conscious response. For example, a high-end accounting package will automatically post information to accounts receivable, accounts payable, inventory, and so forth, based on the entry one makes to the general ledger. The desktop computer operator need do nothing more. At a lower technical level, but frequently favored by many who want personal assurance that remote postings have been made, is software requiring disk-swapping. With these, as an example, once the general ledger entry has been made, the computer prompts, "Load accounts receivable disk." Depending on the software, the entry is then posted without further command, or the user must do so manually. A popular text storage program, which recovers correspondence and the like by key words, stores the key words and their index on the main disk. At conclusion of a successful search it prompts the operator to load the disk it designates so that the full text may be examined and manipulated.

### Time for another decision

If it appears to you that a software program of the type described at these first three levels will satisfy your needs, your decision making is now reduced to only two questions:

- Will it do everything you will ever want it to do?

- Can the system be operated easily so that you and your employees will never hesitate to run it?

A positive response to both questions ends your search for a data management system. It has also saved you \$500 or more.

### Level four

There is a quantum jump, financially and technically, at this level, the so-called Database Management System (DBMS). Purists will insist that this level consists of two types: Data Management Systems (DMS) and DBMS; for this discussion they will be combined. In the main they are, as one writer put it, "complicated little beasts." Yet, they transform the desktop computer into a powerful tool performing functions that only a few years ago were limited to powerful "mainframe" computers.

This type of software should accept data in the format you establish, process the data as you wish, without your having to know how the information is stored. They usually permit accessing more than one data file at a time when posting, comparing, consolidating, printing or generating a new file is required. Your inventory and suppliers files, for example, could be instructed to interact and provide a list of vendors and competitive prices for ordering that next batch of paper. Or you may wish to compare the performance of salespeople in a specific district with the salary levels described in personnel records. The product desired is limited only by one's imagination and the scope of the specific DBMS.

The prospective purchaser of such a system will again have to cope with the semantic challenge. Publishers of this type of program have been shown to be quick and easy in calling a specific software "relational," yet by technical standards it might not be so. It may be "hierarchical" or "networking," or more than likely a combination of two or more of the types. From the user's point of view, the actual type seldom should be of importance, despite sales pitches, if it is efficient, performs all the housekeeping chores necessary and completes its tasks with the speed desired.

To aid in fighting your way through the hyperbole and jargon, a short tutorial on the various types may be of some assistance.

1. *Hierarchical.* As one manufacturer touts it, "This sensible 'family tree' type of design starts with the main subject and then branches out to related information." The aloof B-tree has now become a more friendly "sensible family tree," made

up of the founding root, followed by ancestors, to parents, sons/daughters and descendants. In technical terms, this means that all data is divided into "owners" and "members" in a rigid hierarchy not unlike a genealogical chart. Such software usually assumes that all the data will be processed in a certain sequential order. An inventory program might designate a firm's various departments as "owners," with merchandise as their respective "members." Descend the tree to the department and, in turn, by further branching, the desired merchandise item is located.

For most inventories this would be adequate. But as anyone knows who has attempted to locate an item in a major mail-order catalogue, "hooks" may be found throughout the catalogue, depending on type and the department that sells them. A drawback of a hierarchical design in such cases is that should one wish to locate all "hooks" carried by the firm, every "owner" and every branching path to "members" would have to be explored to render the final tally. The same might prove the case if one desired to know which department carried the "XYZ-brand hook."

2. *Networking.* Complexities arise in the hierarchical design when one attempts to make data modifications (add, delete, update and retrieve), particularly when several people are using the system. The result is commonly error or unreliability. What were called Codsyl proposals introduced "networking" as a solution to some, but not all, of these problems. (If you are confused at this point, consider that purists now refer to hierarchical systems as "sub-systems" of networking, yet many will admit that network designs are hierarchical in structure.) Using what are called "pointers" to relate the items to each other, the network system permits much greater flexibility in accessing and exploiting these relationships. The user is allowed to view the network of files and to wend through them. New connections between such items can be established as time and circumstance dictate.

The drawback is that pointers take up space. In establishing a complex database with branch paths to satisfy different needs and users, it is possible that the space required for pointers could exceed the space of the data itself. This is not always undesirable to achieve greater access to information. There is still some complexity in moving the data around and some rigidity of structure that resists alteration, but for most users the trade-off is well worth it—this may be all they will ever need.



3. *Relational*. This structure organizes the data into rows and columns, making it possible to query any possible relationship between the various elements. Although the user does not see it, each of the individual files is dumped into one large database in this format, making it possible to address only those portions needed for a specific report. Ever-changing combinations of data may thus be merged to meet ever-changing requirements, tasking the desktop computer to its full potential. There are distinct advantages to a relational structure, yet all may not be incorporated into a specific brand package:

- A single source of data with no redundancy of information. Thus, if customer information should change, only one correcting entry is necessary. In contrast, with other database management types in which structures maintain different listings, each list would have to be entered and changed. This is no small task in a large-scale mailing-list environment where, for example, a person is on one list alphabetically, on another list by zip code, and so forth, each of which must be altered when there is a name or address change.
- Greater consistency and accuracy. Applications programs are relieved of the task of managing the data. Searching, sorting and accessing data may require less programming and time.
- More flexibility in the manipulation of data. The user does not have to know where or how the data is located or how it is recovered in order to link elements together in new ways to generate different types of reports.

### Other factors to consider

This idyllic view of data management is marred by reality; the piper must be paid to gain the advantages. Not consistently, but in general terms, the features of a specific brand software package are dependent on price. A few of the things to look for are the following:

1. *Capacity*. The DBMS program, with little doubt, will be the largest program in one's desktop computer system. Data storage requirements often become immense, despite elimination of duplication of data. Accessory programs which ease querying and reporting consume even greater resources. It is often advertised that a "relational" DBMS reduces the amount of storage when compared to the other types. Our advice: look again. Since introduction of a DBMS often tends to require an upgrading of both the com-

**A**t least one manual examined by this writer was incomprehensible and so loaded with data management theory and scant on practice that it would be useless to the beginner. Documentation will be a day-to-day crutch for you and your employees. Be sure that it will fulfill that purpose.

puter and storage media to be used with it, the prospective purchaser must ensure initially that existing hardware or that intended for purchase will be adequate.

2. *Word processor interface*. Does the intended DBMS coexist ("handshake" is the buzzword) with one's existing word processing software, or will yet another word processing procedure have to be learned? Some DBMS have complicated editors with far too many new commands to remember and require learning a confusingly different series of multi-key-strokes.

3. *Language*. Since the DBMS must be instructed to perform the many tasks of which it is capable, some programming language is required. This, by itself, limits a few packages to experienced programmers. Others, although heralded as not requiring one to be adept at programming, are still far too difficult for the novice. Some use interactive or compiler languages with which the user might be familiar, easing the task somewhat. Yet, the user who feels comfortable with an interpreter *Basic*, for example, must remember that its relative slowness will be echoed in the processing time of the DBMS. Other languages are said to be English-like, use English-like syntax, or words to that effect. Whatever the ease or complexity, the language must be learned to exercise the DBMS. To this, the prospective purchaser must insist, "Show me."

4. *Menus*. The first-time user will need all possible assistance in navigating through a DBMS. Here, menus play a vital role. Some software packages forego all but the most basic type of menu; others overwhelm the user with endless pages of menu selections. Find one with

which you are comfortable that will permit you to eliminate some of the menu sequences as you become more adept in using the DBMS.

5. *Documentation*. Considering the cost of most DBMS packages, dealers should be willing to let a potential buyer take the documentation home to be examined at leisure. This is essential. At least one manual examined by this writer was incomprehensible and so loaded with data management theory and scant on practice that it would be useless to the beginner. Some examined were only marginally better if one ignored the stud charts and railroad track schematics. Documentation will be a day-to-day crutch for you and your employees. Be sure that it will fulfill that purpose.

6. *Accessory programs*. Relief for those wishing to embark on DBMS may be found in the several accessory programs being marketed to ease database use without learning fully the DBMS' "language." These convenient utilities assist in instructing the DBMS to accept input, process queries and format output. They are function-oriented, thus costly if a wide range of utilities is required. They also consume even more space in memory and on disk (see "capacity" above). On balance, examine the available utility programs at the same time you compare DBMS. Be warned that there are few such utilities for appointment calendars, accounting, inventory and the like, for the majority of DBMS packages. Your final selection of a DBMS may hinge on available accessory programs.

7. *Security*. All the data of an organization eventually get dumped into the DBMS if it is to display full efficiency and potential. Some of this information is private, privileged or proprietary, and requires protection. If such is the case with your intended application, examine the security-access provisions of each system. Some have no such security mechanism and may be scratched from the list at an early stage.

8. *Error recovery*. Does the proposed DBMS have data safeguards? Since instructions must be in "exquisite detail," what provision does it have to prevent you from sending data to a bottomless pit from which it may never be recovered? What capabilities does the program have in the event that you make what is often called a "fatal error?" Will it "crash" and lose all or a significant portion of your database, or does it recover neatly without such impact? One clue seen often in



the manuals is a warning, "At this point make a back-up disk of your main data file. . . ." Your data is an asset just as is the equipment you use or the merchandise you sell; it deserves equal protection from loss.

9. *Forms.* Without employing the more ambitious forms-generator utilities, most DBMS expect the user to conform to their creators' program design. With a few, you might as well change your line of work; your records, forms and cross-referencing must be changed that dramatically. Some dealers warn of the chaos that may result in attempting to adapt database forms to those used currently in manual systems. It may be that your existing forms are not of this era and some compromise is not untenable with progress.

10. *Speed.* In general, the more complex the database program, the slower it will run. Placing too much of a burden on some systems mires them down. Ask for an identical, predetermined function to be performed on each package examined if speed of processing is one of your important considerations.

11. *Training.* Excellent training programs are available for many of the advanced database systems. Consider their cost in your projections.

12. *Time.* How much time are you willing to devote to training yourself or your employees to manipulate the database program? If you have employee turnover, are you willing to allocate time and money for training new workers, either on the job or through outside facilities?

13. *Ability to update.* Among the finalists in your selection process, try each for various updating applications. Add an item, delete one and change another. The relative ease of some will surprise you; others will be condemned to a deserved fate.

14. *Human factors.* So far, this checklist has shown that to achieve the efficiency and productivity of a DBMS it may be necessary to work at making the dream come true. The small businessperson or professional probably has considered use of a DBMS to facilitate in a more convenient and timely fashion work being done by office personnel or outside contractors. There is no intent to hire a full-time com-

puter operator or systems manager. Your office accountant, for example, is being asked to continue to perform the function for which s/he has years of training and experience. Now, added to the job will be the functions of computer operator, systems analyst and auditor. The DBMS and the accessory programs you select to make this transition, in final analysis, must hold the human factor paramount.

So far unsaid, but apparent in our review of the advanced systems at level four, and some at the other levels as well, is dealer support. Product selection should not be by whim. It requires a dealer to work closely with you to choose the best system for your particular operation, to write a library of those commands you will use most often, and to install the program for you. The services of a dealer qualified in applications of the software and capable of giving the initial training, first-echelon maintenance and continuing advice will pay dividends on your substantial investment. □

---

*The author is a regular contributor to Desktop Computing. Address any correspondence to him c/o Desktop.*

---

## SOFTWARE

# New spread-sheet packages do more than model

ALAN HIRSCH, Datapro Research Corp.

*Highly evolved first-generation programs are giving way to integrated second-generation packages*

Electronic spread-sheet packages are the most popular business application programs for microcomputers. More than 1 million spread-sheet packages have been sold since VisiCalc was introduced in 1979, one for every five microcomputers sold to date. More than 50 VisiCalc clones are on the market, but a new wave of "second-generation" spread sheets threatens to make them obsolete. These second-generation programs are billed as powerful, flexible, friendly, all-in-one microcomputer software solutions, but they are best understood as the direct descendants of last year's diverse spread-sheet software offerings.

## Spreadsheet basics

Why have business people embraced spread sheets so heartily? The reason is that ledger-sheet analysis is a singularly tedious, repetitive and error-prone task. Imagine this scenario: a manager of a large company must submit a report that projects income for the next five years. The manager must assume values for sales revenues, overhead costs, interest rates, repeat business and cost of materials. The manager makes a ledger sheet containing all the information and submits it to the company's controller, who asks that the repeat business be assumed at 80 percent instead of 75 percent. The manager must then recalculate all the ledger values that have been affected by this one change in the repeat-business category. Manually recalculating the effects of this single change is so arduous and time-consuming that very few managers make more than two assumptions per category.

A spread-sheet program transforms a microcomputer screen into a huge ledger sheet. By simulating the rows and columns of a ledger sheet, the program lets a

user work with a large number of interrelated values. When a user changes a given value on the spread sheet, the program automatically recalculates any affected values in seconds. The program not only makes managers' projections less time-consuming and more accurate, it also encourages them to ask more "what-if" questions and to make more complex assumptions.

Although originally intended for accountants, spread-sheet programs are now being used by nearly everyone with a microcomputer who needs to juggle figures. Spread-sheet programs are used to produce budgets, action and profit plans and sales forecasts. They also help produce income statements, cash-flow projections, currency conversions, expense reports and job-cost analyses.

Advanced first-generation spread-sheet packages are concise but powerful tools. They are available for 8- and 16-bit microcomputers running CP/M, MS/DOS, Apple, UNIX and other operating systems. First-generation packages support analysis "grids" of hundreds of lettered columns by hundreds of numbered rows. The packages allow horizontal and vertical scrolling across the grid and split-screen displays for simultaneous display of distant portions of the grid.

First-generation programs support column, row and cell (single-value) editing. With more advanced editing, columns, rows and cells can be right-, left- and center-justified and can contain dollar, decimal, numeric and alphanumeric data. Columns, rows and cells can also be displayed with underlined, flashing, reverse video and color characters. Users can sort entire grids by column or row values and can find and replace specified data values. Spread sheets allow user-instigated and automatic recalculation in user-specified or



## SOFTWARE

---

machine-optimized order. "If-then-else" and other Boolean commands can be used to manipulate values, and preprogrammed average, depreciation, logarithmic, percentage and trigonometric commands are often available. Many spread-sheet programs have been optimized for specific applications, and an active after-market of third-party spread-sheet models (templates) designed to run on popular programs has emerged.

### Support and documentation

Manufacturer support is of prime importance to spread-sheet resellers and end users alike. Manufacturer support may include providing future program enhancements or simply being available to answer occasional dealer or user queries. The buyer should understand the manufacturer's support program before buying or licensing a spread sheet.

Vendor support can include:

- training aids in the form of audio and video cassette tapes and on-line, interactive tutorials supplied as part of a main program or on a separate diskette;
- newsletters for dealers and users that offer suggestions on new program applications;
- telephone hot lines (preferably toll free) to answer dealer and user questions;
- free product upgrades distributed through dealers or directly to end users;
- dealer sales aids, including product displays and video cassette- or diskette-based demonstration packages.

Given the complexity and flexibility of spread-sheet programs, good documentation is vital to user satisfaction and reseller success. Documentation should be organized and indexed for the convenience of both novice and experienced users. It should include illustrations of "real-life" screen situations and many application examples. Sample models should be provided either on diskette or in the manual. There should be a glossary to help the user understand the vendor's colloquialisms, and a pocket reference or command summary for users who have already read the main manual.

Physical appearance may provide a clue to the relative strength or weakness of documentation, but the user should be aware that typewritten, photostated, staple-bound manuals may be less effective than offset-printed, loose-leaf manuals with color and graphics. Looks are not everything though; at least one vendor provides obscure and outdated documentation in handsome, glossy, slipcased binders.

In gathering material for the preparation of this article, Datapro Research Corp. was particularly impressed with documentation from Lotus Development Corp., Hewlett-Packard Co., VisiCorp, Business Planning Systems, MicroSoft, Context Management

Systems and Access Technology. These companies each provide a pull-out or separate reference guide in addition to a user's manual. Access Technology and Chang Laboratories supplement their manuals with separate, well-written booklets on the use of their products.

### Second-generation spread sheets

The first wave of second-generation spread sheets is here, at least according to the vendors and their advertising campaigns. The number of advertising pages devoted to new spread-sheet software is staggering. Underneath the gimmicks, though, second-generation spread sheets share some basic characteristics. They require more main memory to run (typically 128K bytes or more), but they can address almost unlimited amounts of memory. Many packages use virtual memory to accommodate one or more large models, and can compare and combine several models. Software Products International's ProCalc permits simultaneous viewing of four models.

The new packages also offer easier interaction with other applications. Spread-sheet data can be transferred back and forth between word-processing, database-management and graphics programs, and spread-sheet vendors are beginning to build similar programs into their spread-sheet packages. Graphics are an especially popular extra feature. Context Management's MBA program was one of the first to offer graphic representations of spread-sheet-produced grids, and HP, Lotus Development, Desktop Computer Software and others now offer integrated spread-sheet graphics.

Two programs are emerging as leaders among second-generation spread sheets. Microsoft's Multiplan has quickly become the most popular. Some of its advanced features include sorting, global search and replace, menu prompts and an English-like language in lieu of formulas to facilitate user interaction with the program. Multiplan also permits as many as six noncontiguous parts of a model to be viewed simultaneously via window splitting. And, like most second-generation spread sheets, it is fully compatible with VisiCalc-produced files. Microsoft has marketed this program very aggressively through an OEM sales department, and more than 50 word-processing, portable-computer and microcomputer manufacturers have licensed the program to offer with their products. In addition, Multiplan runs on virtually any microcomputer, with versions available for Apple, CP/M-80 and MS/DOS systems. IBM Corp. recently announced it had licensed Multiplan for its Personal Computer despite already offering VisiCalc.

The 1-2-3 program from Lotus, which runs on the IBM Personal Computer and compatible microcomputers, is one of the most complete spread sheets available, requiring 128K bytes of memory. It too is VisiCalc file-compatible and even uses the same key sequences to initiate commands. Some of 1-2-3's distinguishing attributes include an excellent interactive, on-screen tutorial; very versatile cell editing; enriched help



menus, a generous 255-column  $\times$  2048-row grid; and fast recalculation, on-screen sorting and graphic representation. 1-2-3 is priced at \$495, or twice the cost of Multiplan or VisiCalc. Computer manufacturers offering an MS/DOS-compatible product can turn to Lotus for licensing, but may be restricted unless their system supports graphics.

Although some of 1-2-3's graphics are quite crude and do not fully exploit the IBM PC's graphic capabilities, the fact that a spread-sheet array can be specified and quickly converted to color or monochrome bar charts signals an end to the days of reading eyestraining spread-sheet reports. Graphics capability is defining a new category of spread-sheet programs—decision-support spreadsheets. Standard spread sheets made it easier to generate ledger-style financial analyses, DSS spread-sheet programs will make it easier to understand them.

VisiCorp, once the runaway leader, now finds itself scrambling behind well-mobilized and powerful competitors. It is readying its Visi<sup>On</sup> "operating environment" for delivery in December. Visi<sup>On</sup> simultaneously supports multiple applications and allows them to be freely interchanged. Besides its spread-sheet capabilities, Visi<sup>On</sup> supports word processing, database management and graphics. The user interface to Visi<sup>On</sup> is a mouse that connects to the game-control adapter port on an IBM PC. Undoubtedly, VisiCorp will find itself not only competing with systems such as Apple's Lisa, but also with software companies such as Quarterdeck Software, Microsoft, Digital Research and other firms that will certainly introduce similar operating "environments."

The essence of an electronic spread sheet lies in its ability to assess the bottom-line effects of changes in components. But a few target- or goal-seeking spread

## SPREAD-SHEET SOFTWARE GLOSSARY

Electronic spread sheets have brought a set of terms unique to the computer industry. Even the most experienced computer user may be hard pressed to decipher some of the terms and expressions that accompany these programs, and they're more than enough to baffle a novice. To make matters even more difficult, many vendors use different terminology to describe the same things.

- **Active block:** the cell on the matrix that is highlighted by the cursor. Information can be entered, altered or deleted by a user when the cell is active.

- **Active cell:** same as active block.

- **Average:** a function that computes the average of the values in a range or block of cells.

- **Blank:** a command that will erase the contents of a cell or a range of cells.

- **Cell:** a coordinate position on the display. The number of columns multiplied by the number of rows usually equals the total number of cells.

- **Columns:** horizontal divisions of the worksheet that are usually, but not always, identified with letters. Together with rows, columns serve to form the spread-sheet matrix.

- **Coordinate:** the intersection of two numbers and/or letters that uniquely identify the column and row or a cell.

- **Clear:** a command in many electronic spread-sheet programs that irretrievably erases all information on the worksheet.

- **DIF:** a format in VisiCalc that allows other unrelated programs to share stored VisiCalc files.

- **Edit mode:** available in many programs, the edit mode permits easy

modification of cell contents without rekeying the entire entry.

- **Entry:** the value or information contained within a specific cell.

- **Exponentiation:** a function that enables the user to calculate the power of a number. For example, the result of  $8^6$  can be calculated in a single step without multiplying  $8 \times 8 \times 8$  etc.

- **Function:** a process through which values with dependence on other values are calculated.

- **Goto:** a command that permits the user to locate any cell immediately by specifying the coordinates.

- **Global symbols:** symbols that are designated to be displayed in every appropriate cell. Examples of global symbols include asterisks (\*) for crude graphics displays, and dollar signs (\$) to denote finances.

- **Grid:** the display of a model composed of columns and rows.

- **Gridsheet:** same as grid, spread sheet, or worksheet.

- **Label:** the name or title of a column or row assigned by the user.

- **Lookup:** a function that compares a value with a block range and delivers corresponding values from adjacent cells.

- **Matrix:** same as a grid.

- **Model:** a grid that represents calculated and stored data created by the user to assess the interrelationship of variables.

- **Order:** a command found in most programs that permits the user to determine the order of calculation. For example, it may be necessary to calculate row-by-row across instead of column-by-column down or vice-versa.

- **Plansheet:** same as worksheet, spreadsheet.

- **Protect:** a command found in

some programs that permits the user to lock in the contents of a cell, column or row permanently so that the contents cannot be altered.

- **Protected cell:** an entry that has been locked in and cannot be changed. The unprotect statement frees this cell.

- **Range:** the identifying coordinates of a block of cells.

- **Replicate:** a command that allows a row, column or block to be duplicated and placed in another designated position of the model.

- **Rows:** vertical divisions of the worksheet that are usually, but not always, identified with numbers. Together with columns, rows serve to form the spread-sheet matrix.

- **Split screens:** two or more noncontiguous portions of one or more worksheets displayed on the screen and viewable at the same time.

- **Spread sheet:** the grid of columns and rows on the screen.

- **Sum:** a function that adds the values in all the cells of an entry range.

- **Template:** same as model.

- **Title:** same as label.

- **What If?:** the premise on which most spread-sheet programs operate. New values can be substituted to determine the resultant effect on the other values.

- **Window:** the view of the worksheet on the screen. This term is frequently used when the screen is split into two or more windows.

- **Worksheet:** same as spread-sheet.

- **VisiCalc:** the first and most popular electronic spreadsheet program. It stands for visible calculation.

- **Zap:** Same as clear.



sheets allow users to define a result and work backward to see how it could be achieved. The target is entered into the spread sheet, and the program holds it constant by changing or asking the user to change other variables.

Software Arts introduced the first dedicated "how-could" program optimized for target seeking in March. Although not a spread sheet, it employs several spread-sheet principles. Software Arts offers the program, TK!Solver, with a catalog of optional application-specific templates. Software Arts will sell the program directly to the public and through OEMs.

It is apparent that vendors of this new generation of integrated, extended-capability spread-sheet programs

intend to break new ground. Next year, many will offer enhanced packages that will integrate word processing, database management and graphics so skillfully that it will render the current crop obsolete. First-generation and early second-generation spread-sheet programs are still not the complete personal-computer software environments their vendors promote, but they are among the most powerful microcomputer tools available. □

**Alan Hirsch** is an associate managing editor at Datapro Research Corp., Delran, N. J., specializing in the analysis of microcomputer hardware and software.

### Electronic Spreadsheet Vendors

**Access Technology, Inc.**  
6 Pleasant St.  
South Natick, Mass. 01760  
(617) 655-9191  
Circle 824

**American Business Systems, Inc.**  
445 Union Blvd.  
Lakewood, Col. 80228  
(303) 989-3730  
Circle 825

**Antech, Inc.**  
788 Myrtle St.  
Roswell, Ga. 30075  
(404) 993-7270  
Circle 826

**Business Planning Systems**  
Two North State St.  
Dover, Del. 19901  
(302) 674-5500  
Circle 827

**Businessoft International Corp.**  
24 Jean La.  
Monsey, N.Y. 10952  
(914) 352-0021  
Circle 828

**Chang Laboratories, Inc.**  
10228 N. Sterling Rd.  
Cupertino, Calif. 95014  
(408) 725-8088  
Circle 829

**Comshare**  
1935 Cliff Valley Way, Suite 200  
Atlanta, Ga. 30329  
(404) 634-9535  
Circle 830

**Context Management Systems**  
23864 Hawthorne Blvd., Suite 101  
Torrance, Calif. 90505  
(213) 378-8277  
Circle 831

**Creative Software Concepts, Inc.**  
P.O. Box 349  
Binghamton, N.Y. 13902  
(607) 722-3235  
Circle 832

**Cromemco, Inc.**  
280 Bernardo Ave.  
Mountain View, Calif. 94043  
(415) 964-7400  
Circle 833

**Desktop Computer Software, Inc.**  
303 Potrero St.  
Santa Cruz, Calif. 95060  
(408) 458-9095  
Circle 834

**Dynabyte, Inc.**  
521 Cottonwood Dr.  
Milpitas, Calif. 95035  
(408) 263-1221  
Circle 835

**Ferox Microsystems**  
1701 North Ft. Myer Dr., 6th Flr.  
Arlington, Va. 22209  
(703) 841-0800  
Circle 836

**Grid Systems Corp.**  
2535 Garcia Ave.  
Mountain View, Calif. 94043  
(415) 961-4800  
Circle 837

**H & A Computer Systems, Inc.**  
30 Hotelling Pl., Suite 204  
San Francisco, Calif. 94111  
(415) 434-3517  
Circle 838

**Hewlett-Packard Co.**  
19447 Pruneridge Ave.  
Cupertino, Calif. 95014  
(408) 725-8111  
Circle 839

**Hourglass Systems**  
P.O. Box 312  
Glen Ellyn, Ill. 60137  
(312) 690-1855  
Circle 840

**Information Unlimited Software**  
240 Marinship Way  
Sausalito, Calif. 94965  
(415) 331-6700  
Circle 841

**Intelligent Systems Corp.**  
225 Technology Park  
Norcross, Ga. 30092  
(404) 449-5961  
Circle 842

**Lifeboat Associates**  
1651 Third Ave.  
New York, N.Y. 10028  
(212) 860-0300  
Circle 843

**Lotus Development Corp.**  
55 Wheeler St.  
Cambridge, Mass. 02138  
(617) 492-7171  
Circle 844

**MicroPro International Corp.**  
33 San Pablo Ave.  
San Rafael, Calif. 94903  
(415) 499-1200  
Circle 845

**Microsoft Corp.**  
10700 Northup Way  
Bellevue, Wash. 98004  
(206) 828-8080  
Circle 846

**NEC Information Systems, Inc.**  
5 Militia Dr.  
Lexington, Mass. 02173  
(617) 862-3120  
Circle 847

**Osborne/McGraw-Hill**  
630 Bancroft Way  
Berkeley, Calif. 94710  
(415) 548-2805  
Circle 848

**Peachtree Software, Inc.**  
3445 Peachtree Rd., N.E., 8th Floor  
Atlanta, Ga. 30326  
(404) 239-3000  
Circle 849

**Professional Software Technology, Inc.**  
55 Wheeler Ct.  
Cambridge, Mass. 02139  
(617) 497-2077  
Circle 850

**Radio Shack**  
One Tandy Center  
Fort Worth, Texas 76102  
(817) 390-3549  
Circle 851

**Ross Systems, Inc.**  
1860 Embarcadero  
Palo Alto, Calif. 94303  
(415) 856-1100  
Circle 852

**Simple Soft, Inc.**  
480 Eagle Dr. Suite 101  
Elk Grove, Ill. 60007  
(312) 364-0752  
Circle 853

**Software Arts, Inc.**  
27 Mica La.  
Wellesley, Mass. 02139  
(617) 237-4000  
Circle 854

**Software Products International**  
10343 Roselle St., Suite A  
San Diego, Calif. 92121  
(619) 450-1526  
Circle 855

**The Software Toolworks**  
14478 Glorietta Dr.  
Sherman Oaks, Calif. 91423  
(213) 986-4885  
Circle 856

**Sorcim Corp.**  
2310 Lundy Ave.  
San Jose, Calif. 95131  
(408) 942-1727  
Circle 857

**Structured Systems Group**  
5204 Claremont  
Oakland, Calif. 94618  
(415) 547-1567  
Circle 858

**SuperSoft, Inc.**  
Box 1628  
Champaign, Ill. 61820  
(217) 359-2112  
Circle 859

**Systems Plus, Inc.**  
1120 San Antonio Rd.  
Palo Alto, Calif. 94303  
(415) 969-7047  
Circle 860

**United Information Services, Inc.**  
6626 Convoy Ct.  
San Diego, Calif. 92111  
(619) 560-7070  
Circle 861

**United Software Co.**  
2431 E. Douglas  
Wichita, Kansas 67211  
(316) 684-5281  
Circle 862

**Vector Graphic, Inc.**  
500 N. Ventu Park Rd.  
Thousand Oaks, Calif. 91320  
(805) 499-5831  
(800) 235-3547  
(800) 322-3577 (Calif.)  
Circle 863

**VisiCorp**  
2895 Zanker Rd.  
San Jose, Calif. 95111  
(408) 946-9000  
Circle 864

# THE NEW WAVE OF COMPUTER GRAPHICS

By Alexis Driscoll and Robin Howard

**C**omputer graphics in business applications is fast becoming an essential tool for time-pressured managers. Sales of graphics software are projected to grow at a rate of 40% per year through the '80s, making graphics one of the fastest growing markets in software. What can DP managers do to meet the growing need for graphics without increasing the drain on their personnel and systems? One solution is distributed graphics for microcomputers.

Graphics is a valuable tool for managers for several reasons. Studies have shown that visual presentation of information markedly increases both the speed and volume of comprehension. Meetings are on the average 28% shorter, which is a boon to managers who are estimated to spend up to 60% of their time in meetings. Ease of comprehension aids the manager in reviewing and analyzing data. In addition, graphics presentations are attractive to business users because they have been shown to be more persuasive. As a result, the demand for business graphics (Continued on Page 78)

is increasing and will continue to do so. The type of situation that requires business graphics places a special burden on the department, creating a problem for the information manager providing graphics. Executives operate in a data environment fundamentally different from production applications. Decision support and the presentation of analysis often require data over a longer time frame. They involve more summarization and less detail. When the analysis involves current or projected data, that data is often dynamic, sometimes variable or uncertain and often difficult to define.

In addition, the situation giving rise to the demand is different. Ad hoc needs and last-minute changes are frequent, making rapid turnaround essential. Presentation graphics are often customized, requiring close interaction between the manager and the program.

When all graphics capability is located in the DP department, the increased demand for nonstandard output places a new strain on the facility. One solution is to cut loose those nonstandard, nonroutine tasks by implementing microcomputer graphics software.

Business graphics on microcomputers resolves the problem from both sides. Use of micros relieves DP services of tasks that are unnecessary or inappropriate. From the manager's

***When all graphics capability is located in the DP department, the increased demand for nonstandard output places a new strain on the facility. One solution is to cut loose those nonstandard, nonroutine tasks by implementing microcomputer graphics software.***

perspective, the ability to interact with the program eliminates the problems of an intermediary between the manager and the system. Managers can get the graphs they want. This interaction is essential both to analysis of data and to customizing graphs. Secondly, since they or their staff create the graphs themselves, they control the turnaround time. They get the graphs when they want them.

Turnkey systems, which provide hardware (usually minicomputers)

and software dedicated to graphics, offer some excellent graphics capabilities. However, when they are contrasted with personal computers that have off-the-shelf software, there are several trade-offs to consider.

The first trade-off is cost. Turnkey systems cost in the range of \$35,000 for up to approximately six units. Add-ons cost approximately \$12,000 to \$15,000 each. By contrast, a stand-alone micro unit including hardware and software costs less than \$5,000. In many cases, the hardware is already in place, reducing the expense to a range of \$200 to \$600.

The second trade-off is the cost-benefit ratio. In the realm of micros, cost is not the distinguishing feature. Even if both the cost of the micro and software are considered, when compared with a turnkey system, it is possible to purchase approximately 80% to 90% of the capability for 10% to 15% of the cost — or less.

The last trade-off involves the tactical issues raised by a turnkey system's cost. A high price provides an argument for centralization of the expensive resource in order to maximize utilization. This centralization is directly contrary to the intent of distributing graphics capability to the user. Much of the ease of access, if not ease of use, is sacrificed.

Before evaluating programs, it is essential to determine the needs that

the programs must serve. Until recently, presentation was the primary function of business graphics, and it is still the most basic and first-used application.

The more important the presentation is, the more aesthetic options are required of a program. How much control over the visual image is required? User needs may be defined within the following parameters:

- **Graph types.** How many are there and how sophisticated? Can you overlay one graph on another, such as a line above bars? Can you place two graphs side by side on one axis, such as a line beside bars? Can you create horizontal bars? Can you have more than one graph on a single page?

- **Range of axes.** How many variables can be displayed, including legible labels? Some programs can accept many data points but cannot legibly display 24-month labels. Can you control the frequency or appearance of labels?

- **Control of axes.** Does the program calibrate the range? Can you set the range?

- **Color selection.** How many colors are available for screen presentations and slides? How many can be displayed on the screen at one time? Can the users specify background as well as foreground color? Does a color program display on a monochrome monitor?



• *Text on graphs.* How many titles are there? What types: axis or legends? Are they vertical as well as horizontal? Can titles be placed anywhere on the graph such as numbers on top of bars? How many fonts are possible? Can you create word charts? How many fonts can appear on one screen?

• *Selection of fill, line, mark and grid type.* How many options are there? Can you specify them or are they in a fixed cycle?

As managers have become more accustomed to visual data through the use of presentation graphics, demand for analytic graphics has increased and will continue to increase. Many simple forms of analysis may be performed within certain micro graphics programs.

It is essential to determine the sophistication of the analysis to be performed. Trend analysis should be considered. Is spotting trends visually the extent of analysis or is curve fitting required? How much statistical analysis is required? Is drawing a trend line sufficient or should the program generate points along the curve as well?

Data transfer and manipulation should be considered. How extensive is the data? How much manipulation does it require? Some programs transfer data, with varying degrees of ease, between spreadsheet programs and graphics programs. Some programs allow simple data manipulation within the program itself.

Do managers receive information routinely? If so, there are programs that allow the creation of standardized graphs similar to those produced on a mainframe. Parameters of the graphs can be established once, and subsequent users need only edit data.

Once an application profile has been developed, there are two other variables to consider: desired output and time. Output varies considerably in quality, time and cost. For particular informal presentations, monochrome charts produced on a printer are quicker and less expensive than color charts produced on a plotter. These options, as well as the ability to create slides and transparencies, are not only a function of the hardware, but also of the software's ability to interface with it. Some programs also allow the presentation of sequenced displays on the monitor in place of slide shows.

Where software is concerned, less time is not necessarily a function of more money. Some programs that are comparably priced are slower than

others. Programs vary in the time it takes to process an entry. More importantly, programs vary in the time it takes to load, change graph styles, change data and transfer data. When multiple charts are produced, time becomes an important factor.

Once users' needs are determined, the programs to meet those needs can be evaluated. There are several criteria to apply.

A program chosen for one application, such as analysis or presentation, should contain a breadth of options associated with that application. If the program contains several applications, such as analysis and presentation, opt for sophistication. Some multiple applications programs, particularly within integrated programs, are excellent introductions to graphics, but are outgrown very quickly even by inexperienced users. Expect user sophistication to grow rapidly at first. Similarly, expect a proliferation of data requests and opt for a program that most easily ac-

***If the program contains several applications, such as analysis and presentation, opt for sophistication. Expect user sophistication to grow rapidly at first. Similarly, expect a proliferation of data requests and opt for a program that most easily acquires data from a multitude of sources.***

quires data from a multitude of sources.

Currently, there are no truly portable graphics products available for microcomputers. However, some products can become standards in a micro environment if the same program is available on several of the major brands of micros. In an environment in which several brands are already in place, user training is simplified. In addition, user retraining is not required as users change or add different brands.

The addition of peripherals will constitute the richest and most prolific growth where graphics is concerned. The ability to grow in a logical and controlled pattern requires

software that interfaces with a broad range of peripherals.

Software must be able to utilize the logical intelligence of peripherals. Without this ability, the performance of peripherals such as plotters and printers will be constrained with regard to such items as scaling, fill types, font styles and color.

The importance of ease of use cannot be overstated. Managers need a program that is easy to learn and easy to use. The first prerequisite is either menus or English-like commands. Menus have the advantage of being easy to learn at first, but a common complaint is that more experienced users find them awkward and slow. If a high turnover of users is expected, then menus may be the best choice. However, users who expect to use the program frequently will likely opt for a command interface with English-like commands.

If the program is meant to customize graphics or experiment with data, it should be easy to use. Standard formats are only easy for producing standardized graphs. It should be easy and quick to change your mind about the type of graph, graph elements and data input. It should be easy to preview the graph while it is being created.

When choosing between two comparable programs, choose the one with better documentation. Documentation that is thorough and easy to understand is the key to users learning the program and developing their skills. It should include a tutorial with exercises for the novice and a variety of reference materials for the experienced user. On-screen tutorials are an excellent tool for overcoming reluctance to interact with the program. Look for a comprehensive reference section within the manual and, foldout or pocket charts for quick reference. In addition, look for comprehensive Help screens within the program.

Telephone customer support, in which the manufacturer answers user questions about the program, can deflect much of the onus of training and troubleshooting from information managers. Support varies among vendors. Some have formal customer support programs, while others deal with questions on an ad hoc basis. Some have toll-free numbers; others do not. Since questions will continue to arise as user skills develop and equipment is added, quality customer support is an essential time-saver.

When micro graphics is introduced to a firm, the use of graphics and its variety of uses tend to mush-

## COMPUTER GRAPHICS

room shortly thereafter. When first surveyed, many potential users cannot conceptualize their graphics needs. However, once graphics is accessible to them and they become familiar with its capabilities, either directly or through others, applications multiply. Users also become more sophisticated in their skills. In addition, some of the demand for graphics comes from the recipients of graphs, not the creators. Executives soon discover the value of graphics presentations and demand more of them. For all these reasons, it is wise to allow options for expansion when making initial purchases.

Although expansion may be an upgrading to more sophisticated programs or hardware, it may also be just a proliferation. The two should not be mistaken. Not every application requires an 8-color plotter or a statistical package. Planned expansion will consider upgrading equipment, but also the provision of a variety of options regarding speed, quality and capacity.

The micro invasion of the office is a fact. But microcomputing is personal computing. The name is an index of its use. It is not a replacement for the tasks normally performed by DP departments, but rather a supplement. It has the added advantage of relieving DP of current tasks that drain its resources, tasks that are better performed elsewhere.

Graphics is an excellent example of such a task. With the advent of microcomputers, many nonstandard, ad hoc graphics tasks can now be located where they belong — with the user.

Graphics is just being introduced into the business environment in quantity. Now is an ideal time for professionals concerned with information management to intervene to assure that this new wave of information processing is properly managed. ♦

*Driscoll is a marketing consultant and a Masters candidate at MIT's Sloan School. Howard is a product manager for Business & Professional Software, Inc., Cambridge, Mass.*

# The Communicators

Larry Jordan

*Telecommunications can broaden your horizons and make your computer more useful. This look at the most important features of communications programs will help you select the one that's right for you.*

When my IBM PC was delivered in February 1982, I selected a communications software package easily. The only two available were COMM.BAS, which came on the PC-DOS disk, and the *IBM Asynchronous Communications Support* package. I did not know much about personal computer communications at the time, but the thought of being able to operate the office mainframe from my house intrigued me. Without knowing what I was getting into, I immediately purchased the *IBM Asynchronous Communications* package, a Hayes Smartmodem, and an asynchronous communications adapter. After putting all the pieces together and making several awkward attempts to communicate with the office Prime computer, I really started rolling. I could use my modem to converse with the Prime, and the modem would dutifully follow my every whim. I could also churn out hundreds of lines of FORTRAN without going anywhere except to the refrigerator for a soda. I felt I had all I would ever need for communications until I discovered electronic bulletin boards.

The first time I called a local bulletin board I learned that my communications software was not quite as capable as I had thought. There were software patches (a fancy word for software enhancements or error corrections) and games available on the board, but I had no way of capturing the program listings as they scrolled by on my monitor.

By talking with friends I learned that I needed software that would transform my IBM PC into a smart terminal with the ability to send and receive disk files. The *IBM Asynchronous Communications* package was supposed to provide that capability, but it had many limitations. After several futile attempts at modifying the IBM package, I gave up and started adding enhancements to the COMM.BAS program. It was at about this time that I received my first copy of an absolutely wonderful communications package called *PC-Talk*. Not only did this package give me the smart terminal capabilities I needed, but also excellent documentation and easy-to-follow source code.

Since those early days of PC communications, many powerful smart-terminal communications programs have been released for the PC. Some were initially designed for CP/M-based computers and have been converted to operate under PC-DOS; other new packages have been written specifically for the IBM PC. My latest count showed over 20 commercially available packages and 5 public domain packages. Due to the large number currently available, it is more difficult than ever to choose a package. To make the task easier for a PC owner just getting into communications, I have described the characteristics and capabilities of communications packages. I have also briefly reviewed 12 communications packages and developed a summary matrix that shows how well communications capabilities have been implemented in these packages.

## Essential Characteristics and Capabilities

As with any other software package, no single communications program is likely to satisfy all wants and needs. The best one can hope for is to find a package that provides most of the essential features and some additional nonessential but desirable features.

Although business and personal applications of communications software are often different, some common communications capabilities are required by both. Business and personal applications must usually have the ability to send and receive disk files and to communicate in terminal or conversation mode. Business software, however, will often have to support the volume of large files that are transferred in many business communications applications. The following paragraphs discuss the common capabilities needed in these two types of software. The unique features of each are discussed later in this article.

### Communications Parameter Selection

To properly communicate with another mainframe or microcomputer (called the *host system*), you must be able to select the appropriate communications parameters required by the host system. These parameters include baud rate, number of data bits, type of parity error-



## ● Review

checking, and number of stop bits. The communications software may provide default values for these parameters, but it must also provide the option of modifying the default values both before and after a connection is made with a host system.

### Duplex Mode Selection

A communications package should provide a way to switch between half-duplex and full-duplex modes, because business and personal communications applications often require connection to both half-duplex and full-duplex host systems. Most information services and bulletin board systems operate in the full-duplex mode, but other microcomputer and mainframe systems may operate in half-duplex mode.

### Command and Conversation Modes

Communications software should be operable in a command or a conversation mode. The command mode is required for off-line communications between the PC keyboard and the communications software to perform functions that do not involve the remote host system. For example, operations such as changing a telephone num-

---

I felt I had all I would ever need for communications until I discovered electronic bulletin boards.

---

ber in a dialing directory or viewing selected communications parameters have to be conducted without interaction with the remote host system. When off-line command mode functions have been completed, however, the software must be able to return to the on-line conversation mode to continue interactive communications with a host system.

### Error Handling

A software package's ability to handle data errors is vitally important. A good package should either warn you before an error occurs, so that preventive action can be taken, or provide a clear error message when an error does occur. The package should also allow you to continue with communications despite a minor error. Operations that can result in significant errors should also be designed to let you abort a command before the error is made. For example, if an attempt is made to return to the operating system before captured data has been saved, you should be told that the data will be lost. You then should have the chance to go back and save the data before finally returning to the operating system.

Feature
Data capture direct to disk file
Data capture to memory buffer
On-line display of capture buffer
On-line editing of capture buffer
Filtering of received control characters
Optional add/delete of linefeeds
Upload wait for host prompts
Upload text throttle (delay between lines)
Menu of prestored uploadable strings
Transmission of prestored strings
Transmission of a true break signal
Tab to space conversion
XMODEM protocol file transfer
Protocol error-checking file transfer
XON/XOFF support during file send/receive
Non-ASCII (binary) file transfer
Operation with non-auto-dial modem
Auto-dialing telephone directory
Auto-dialing modem support
Auto-redial of last telephone call
Auto-redial of last call until connect
Modem/telephone hangup
Return to operating system without hangup
Elapsed time of call display
On-line switch between originate/answer
On-line selection of duplex with toggle
On-line selection of comm parameters
On-line listing of selected parameters
On-line printer on/off toggle
On-line viewing of disk directories
On-line viewing of disk files
Deletion and renaming of disk files
1200 baud receive/download operation
Save/reload of customized parameters
Batch operation from operating system
Command file power/flexibility
Remote takeover and operation
Efficient use of available memory
Display of help files
Line 25 abbreviated help menu
Ease of command key use
Quality of user manual

## ● Review

### Data Capture

Data capture, also called downloading, is the process of storing received data in memory or in a disk file. Most communications applications will require this capability. Some packages allow data capture directly to a disk file, whereas others allow data capture to random access memory for later storage in a disk file. Some packages provide both options. Most hobbyists don't need capabilities other than direct-to-disk capture, but some business applications require the memory capture option so that the captured data may be modified before it is written to disk.

Some communications packages also let you select the type of data to be captured. You can elect to capture only incoming data transmitted from a host system, only outgoing data entered from the PC keyboard, or both incoming and outgoing data. This option is good for business applications, but most hobbyists can live without it. If only local keyboard input is being captured, a file can be opened and a series of batch mode commands entered into the file. Then the file can be closed and immediately put into operation. Frequent use of this option can improve the efficiency of data communications and reduce communications costs for a business.

### Data Upload

The term *upload* is used to describe the process of transferring a local disk file to a remote host system. Both business and personal communications make use of this capability to transfer files containing memos, reports, data, or programs to remote computer systems.

### Data Capture to Printer

A communications package should have the ability to simultaneously display and print out data as it is received over the phone line. Sometimes it is necessary to print a computer conversation with another person or the menu of files that can be downloaded from a bulletin board to eliminate repeat listings of the menu during download file selection. You may also want to get a printed record of sessions with time-sharing systems for future reference. This feature is particularly useful when transactions result in fund transfers.

A single key toggle that turns the print function on and off without interrupting the transfer of data is also a desirable feature. This option allows the user to send text selectively to a printer by pressing one or two keys. Software that requires you to go into the command mode to turn the print function on is cumbersome and requires either an interruption of incoming data flow or a pause in outgoing data transfer before printing can be initiated. This frequently results in the loss of desired data as it scrolls off the screen.

### XON/XOFF Support

File transfer applications that involve data transmission rates greater than 300 baud often require the XON/XOFF communications speed-matching protocol. This protocol allows the software designer to use less memory (RAM) for a communications receive buffer (an area reserved to hold incoming data) because communications

---

**You should not have to reboot the computer each time a communications session is completed.**

---

speed-matching will not have to be handled solely by the buffer. When the buffer begins to fill up as the result of a speed mismatch, the software tells the host to stop sending data by issuing an XOFF character. When the buffer is emptied, the software signals the host to resume sending data by issuing an XON character. Most mainframe computers use this XON/XOFF protocol, so business applications that involve file transfers with mainframe computers can make use of the capability.

### Manual and Auto-Dial Modem Support

Even though you might have only a manual-dial modem, when selecting a software package it is a good idea to get a package that will support both manual and auto-dial modems. Having a communications package that supports only manual-dial or auto-dial modems limits flexibility in hardware configurations. With the current rapid increase in modem capabilities and the rapid drop in modem prices a new auto-dial modem may become a necessity long before expected. An auto-dial modem might also have to be relinquished for a period of time for repairs, resulting in the need to use a spare, manual-dial modem.

### Dialing Directory

When a software package allows the storage of telephone numbers that can be used with auto-dial modems to access remote systems, the package should also allow the user to list the directory of available telephone numbers. Numbers that are buried in command or batch files are inconvenient to locate when they have to be dialed without using the command or batch file. It is also good to have a brief summary listing of the major communications parameters that will automatically be invoked when a number is dialed from the directory.

### Originate/Answer Mode Switch

To receive a call from a remote terminal or another computer, the modem must be switched from the originate



mode to the answer mode. Manual-dial modems provide a switch that activates the mode change, but intelligent modems may be switched manually or through software control. Communications packages often allow you to switch from one of these modes to another by pressing one or two keys.

### 1200 Baud Modem Support

A communications package should be able to support both 300 and 1200 baud (bits of data per second) communications. The ability to upgrade from a 300 baud modem to a 1200 baud modem without buying a new communications package can save software and training costs. Almost all communications packages use different commands to perform the same function, so changing to a new package means that communications users have to learn new commands.

### Return to Operating System

A communications package's ability to return control to the operating system is often overlooked when a package is being evaluated. You should not have to reboot the computer each time a communications session is completed. Entering a simple command should enable you to leave the communications program and return to the operating system to perform other computer operations. Many packages use a function key or an Alt-key combination to provide a shortcut back to the operating system. Other packages require you to go through a series of menus before returning to the operating system. Either option is acceptable, but the single- or dual-key shortcut is faster to execute and easier to remember.

### Disk Directory Listing

Another useful feature is the ability to list the disk directories of all disk drives. When you are uploading files, this function allows you to select files for transfer. When you are downloading files, it allows you to select file names that are not currently in use. If the program stores communications parameters in disk files, the disk directory listing provides a menu of parameter files. For programs that support batch file operation, this option allows a menu of available batch files to be displayed.

### Prestored Strings

Frequent communications with systems that require log on commands can mean a great deal of repetitive typing. In such cases prestored character strings that can be transmitted to a host system are a useful feature for both business and personal applications. Many communications software packages for the PC allow prestored strings to be uploaded with one or two keystrokes, making this feature even more convenient. When prestored strings are provided by a package, the user must be able

to list the strings quickly while logged on to another system; it is easy to forget which string goes with each key, so a quick reminder is sometimes necessary.

### Break Signal

Many mainframes and some information services require a break signal to interrupt program execution. A communications package should be able to send a 200- to 600-millisecond sustained high signal (equivalent to a logical 0) with one or two keystrokes. This signal will interrupt a program in progress or get the immediate attention of an information service system.

### Operating System Required

Care should also be taken when selecting a communications package, because available packages may operate only under PC-DOS, CP/M-86, or the UCSD p-System. Some packages will run under only one of these systems, but others are available for more than one operating system. A package designed to run under one system will not operate under another. Files downloaded using a CP/M-86 communications package cannot be accessed later under PC-DOS because the disk formats are different.

### User Help Files

Help files are important in frequently used communications packages. They are also helpful for the user who is not accustomed to a particular package. Help files are not a replacement for a good user manual, but they provide a quick reference for the keys required to perform certain functions. These help files should be readily accessible and written in clear, concise English.

### Documentation

A communications package is incomplete without a good user manual. A package that contains all the features described above is of little use without a manual that tells how to use the features. A manual does not have to contain the background information on communications, but it must fully explain each feature.

### User Support

When all else fails, you must be able to get support from the software publisher. Good user support means that a technical person is available when needed to help solve applications problems. No communications software package is perfect, particularly new ones on the market, and most of the problems encountered cannot be solved by a software salesperson. Before purchasing a software package, you can check with local IBM PC user groups and other people who own and use the package to be sure it is well supported.

## ● Review

### Additional Desirable Features

Many commercial communications applications require several software features beyond those described in the previous section. The PC must deal with mainframe communications idiosyncrasies, which may include communicating in more than one character code (for example, ASCII and EBCDIC). Business communications may also require frequent large file transfers or multiple file transfers beyond the scope of personal communications. Differences in work hours and time zones may also require unattended-operation communications capabilities.

#### Upload Throttle

When files are being uploaded to a mainframe system, it may be necessary to match the file transfer rate with the response of the mainframe. Some host computer systems will not allow you to send a line of data until you are prompted to do so. The prompt, a signal indicating that the mainframe is prepared to receive more data, may be a letter, a character, a number, or a combination of all three. Data sent before the prompt is received are usually lost. Uploading a file to such a system without providing a mechanism to wait for prompts results in the truncation of each line; a subsequent listing of the file will show the beginning of each line missing. To match the upload speed of the IBM PC with the system response of a mainframe, it is sometimes necessary to throttle the upload.

Communications software packages provide several types of upload throttles. The three major types are time delays, character receipt delays, and character prompt delays. A time-delay throttle allows you to select the length of the time delay between the upload of each line of data. A character-receipt delay throttle allows you to specify the number of characters that must be received from the mainframe before a new line of data is uploaded. A character-prompt delay allows you to specify the exact character string that must be received from the mainframe before a new line of data is sent.

#### Linefeed Control

Some communications software packages add linefeeds after each carriage return received or transmitted, but others do not. Business communications software should let you decide whether to have linefeeds sent following each carriage return or added after each received carriage return. Without this capability, transferred files may have to be edited to remove or add linefeeds and conversation mode communications may be difficult to perform.

If a linefeed is being added to each transmitted line by a remote system and another one is being added by the PC's communications package, the received data will have a blank line between each line of data. If linefeeds are not being added to the end of each transmitted line

by the host and the PC's communications package is not adding one, the data received by the PC cannot be listed and edited until linefeeds are added. If data is being received in the conversation mode and neither the IBM PC

---

Prestored character strings that can be transmitted to a host system are a useful feature for both business and personal applications.

---

software nor the remote station software is adding linefeeds at the ends of data lines, each line will overprint the previous line on the PC monitor, making it difficult to read the data.

#### Binary Data Transfer

A full-featured communications package should allow the transfer of non-ASCII files. It is often necessary to transfer machine code files, rather than source code, to protect the source code from being stolen or modified. Some BASIC language communications software will not send or receive machine code, because some of the binary strings contained in the files appear to the communications program as end-of-file markers, causing the transmit or receive mode to terminate abnormally. Business applications usually require that communications software be designed to overcome this problem.

#### Protocol File Transfer

The term *protocol file transfer* is used by many software vendors to describe special file transfer techniques. These techniques are different for each package, but they generally do the same thing. The protocol signals (sometimes called *handshaking*) used by these packages allow them to transfer text, data, and machine code files and to perform sophisticated error checking to be sure files are transferred properly. The handicap in using these protocol file transfer techniques is that the computers on both ends of the communications link must be using the same software; there is no standard that governs these protocols and no two are exactly alike. This means that a business must standardize its communications software to take advantage of protocol transfers.

#### Remote Control

Some IBM PC communications packages allow users to call in from a remote location and take over the operation of a computer as if they were sitting in front of it. To perform this function both systems must be using the same software. Businesses can use this capability to



## ● Review

transfer files to or from an unattended computer. For example, a branch office can send a file to the home office in another time zone before or after normal working hours.

### Command Files

Command files allow the storage of several parameters in a disk file for repeated use. These files may contain many or all the software package commands that can be entered from the keyboard. Communications parameters such as parity and number of data bits may be modified, and a telephone number can be automatically dialed by a command file.

### Batch Mode

Batch mode operation is similar to command file loading and execution, but it supports several commands not supported by command files. A command file can modify communications parameters and dial a telephone number when used with an auto-dial modem, but a communications operator must take over to continue the session after the communications link is established. A batch file can modify communications parameters and dial a telephone number, but it can also continue the communications session after the connection with the remote system is established. Log on messages can be sent and files transferred between the IBM PC and any other system without operator assistance. A batch file may also be written to delay execution until a specified period of time has elapsed.

### Character Filter

Some mainframe and microcomputer communications software transmits control characters. These characters do not print on most computer terminals, but the characters are printed on an IBM PC. To eliminate these annoying and sometimes confusing characters, the program must filter them out of the incoming stream of data. Some PC software packages allow the user to turn the filter on or off by executing a command string. Business applications that require remote demonstrations of software running on a computer that transmits control characters would benefit from the filter option.

### Translation Table

Translation tables allow the program to redefine incoming or outgoing character codes. Any of 256 codes can be redefined so that a different character code is passed to the IBM PC than the one received, or a different character code is sent out through the communications port than was entered at the keyboard. EBCDIC code for a given character can thus be converted into ASCII code. Certain characters can be redefined as nulls or spaces or can be left out of the translation table entirely so that they will be filtered out of incoming or outgoing data.

### Tab-to-Space Conversion

The IBM PC sometimes uses tab (Control-I) characters to represent spaces in stored files. These tab characters save valuable disk space by representing up to 8 spaces each. Other systems, however, do not always follow the same convention. To keep files that contain tab characters intact, it may be necessary to convert tab characters into spaces. Several IBM PC communications packages provide a facility for turning this automatic conversion on and off by issuing a command from the keyboard.

### Telephone Hangup

Some business communications involve systems that do not automatically break the telephone connection when you log off. To break a connection with one of these systems, you should be able to execute a software command that "drops the line" when an auto-dial/auto-answer modem is being used. Without this option the modem might have to be turned off to break the connection, and frequent off/on cycling of a modem may shorten its life.

### External File Manipulation

It is often necessary during a communications session to delete old files as new ones are created. It may also be necessary to rename files created by a communications software package (for example, a command file) or those that have been improperly named during file downloading. It may also be necessary to run a BASIC program or execute a DOS command (for example, a FORMAT or CHKDSK command) during a communications session. These operations can be done more quickly and easily if they can be performed without exiting the software package. The IBM PC communications packages that provide these options should save a company time and money if file transfers are performed frequently.

### Auto-Redial

Some local information services used by hobbyists run on microcomputers and allow only one user at a time, while others have a limited number of incoming connections. The telephone numbers of these services are frequently busy. Instead of manually redialing a number from the keyboard, an auto-dial modem may be software controlled to redial a telephone number until a con-

---

The XMODEM protocol can be used to receive binary files, but the host computer must be able to send files using that protocol.

---

nection is made. Software packages that offer this capability also provide an alarm signal that gets the

## ● Review

user's attention when the carrier signal of a remote system is finally detected. It is often necessary to use an auto-redial to get through to a bulletin board system on weekends or holidays.

### Elapsed Time of Call

It is convenient to have an elapsed-time-of-call indicator when communicating with a time-sharing information service. Information services generally charge a rate based on connect time, so the elapsed-time indicator can help save connect-time costs. This feature can also serve as a reminder of costs when calling a long-distance number to get in contact with a host computer system.

### XMODEM Protocol

Most CP/M bulletin board systems use the Ward Christensen XMODEM protocol to transfer files. This protocol is similar to the protocol file transfer technique described earlier in this article in that it requires a protocol-matched system; the XMODEM protocol, though, is in the public domain. (See "XMODEM Comes to the PC.") Software that supports this file transfer technique allows the user to take advantage of 99.6 percent error-free file downloading from CP/M bulletin boards. The XMODEM protocol performs checksum error detection for transferred blocks of data, and blocks containing errors are automatically retransmitted.

## Evaluating Communications Software

The evaluation and selection of a communications package may not be an easy task. Changing needs and capabilities in a business environment and changing budgets in a hobbyist situation contribute to the complexity. But as is the case with other software packages, decisions have to be made based on the best information available.

The initial step in selecting a software package is to assess your communications needs. A list of all essential features should be developed, followed by a list of desirable features. Only then should available communica-

---

## Public domain and inexpensive BASIC programs are excellent learning tools.

---

tions software packages be considered. An evaluation matrix similar to the one shown in Table 1 allows you to place communications packages in proper perspective by showing their strengths and weaknesses graphically.

As part of the evaluation of communications software, experience with any package is valuable. Public domain and inexpensive BASIC programs are excellent learning tools. You can experiment with these simple programs and learn a great deal about communications through trial and error. There are many bulletin board and private host systems operating in major metropolitan areas that can be used as guinea pigs during this learning process. Mastering a simple BASIC communications program will help you evaluate the capabilities you will need for serious communications.

---

*Larry Jordan is a freelance writer who manages power plant startup engineers for the NUS Corporation. He has coauthored the book Communications and Networking for the IBM PC, to be published this summer by the Brady Company.*

*(EDITOR'S NOTE: Excerpt from original article - discussion of specific communication packages extracted).*



# Integrated Software More Than Meets the Eye

BY KATHRYN COGSWELL, APPLE

The meaning of "integrated software" can vary from one software vendor to another. For users, however, the term clearly combines two elements: ease of use and software availability. Because ease of use and software availability are key issues in the selection of desktop computer hardware, it is appropriate to examine how they are influencing desktop development and just what is meant by integrated software.

The various integration levels of current microcomputer software offerings can best be understood through an examination of the following key issues: open vs. closed systems, user interfaces, file compatibility levels, multitasking vs. single-tasking and hardware/software requirements. Some current offerings will be examined with an eye to how they address these issues.

**Open vs. closed systems:** Will the number or type of applications that can be performed be restricted by the software and how the software is employed? If not, the system is an open system. If applications are restricted, it is a closed system. Context Management Systems, Inc.'s MBA is a closed system.

The open vs. closed issue also addresses the relationship between hardware and software. Is there anything in the way the hardware and software interact that affects where and how the integrated software can be used? Apple Computer, Inc.'s Lisa exemplifies this type of system.

**User interface:** The most important part of an ease-of-use criterion may be a common command structure that presents a consistent user interface. Ease of use provided by the integrated software should also respect the user's growing proficiency or infrequent usage. This may imply some sort of intelligence in the software—at least the ability to suppress or resurrect levels of help. The degree of integration is also reflected in the levels of help offered, such as the use of graphics-based guidance (or icons), menus, mice, mnemonics or on-line textual help.

**File compatibility:** File compatibility is frequently an important reason behind the development of a desktop computer acquisition policy. Simply

put, file compatibility is the ability to move easily manipulatable information between applications programs. In the most advanced form, this ability should take place regardless of location (on coresident programs, between peers or to a higher processing level—the mini or mainframe). In highly integrated software, changes made in one application would be reflected automatically in all relevant others.

**Multitasking vs. single-tasking:** Does the software provide the ability to perform more than one application at the same time? Multitasking capability (also known as concurrency) is provided by some of the integrated software vendors. It allows the user to work on multiple tasks concurrently, switching among them in a way that reflects ordinary work patterns. Single-tasking capability is the operating procedure of stand-alone applications packages; it is also the operational mode of some integrated packages, although they have reduced the time required to switch between applications by putting them all on a single disk.

Concurrent processing, particularly in conjunction with windowing, facilitates quick referencing and information transfer between applications, to the end of mimicking the way a person works on a given project.

Multitasking should not be confused with multiprocessing, a future desktop computer capability. Multitasking is a subset of multiprocessing. Multitasking is a feature of some integrated software

packages (and the concurrent CP/M operating system); multiprocessing is generally not employed at the microcomputer level because of the limitations of most current microprocessors.

**I**n a multitasking environment, the processing power of the unit is shared among multiple applications on a one-at-a-time basis. The user works on one application with the processing power of the desktop computer directed to that application. The user may stop work, suspending the actual processing of the application while he switches to another application. Because of the speed involved, the suspension of processing is often totally transparent to the user.

In a multiprocessing scenario, the processing power is split among applications. All applications appear to the user to be processed simultaneously. The processor is in fact still processing them one by one, but alternating instructions from each just enough to process them as jobs.

An analogy of multiprocessing could be based on the circus performer who sets a series of spinning plates in motion. The performer must move from plate to plate, setting each in motion, then returning to each to give it enough of a push to keep it spinning till he is able to return with the second, third and fourth pushes and so on.

Visualizing how application windows would work in both types of environments helps to illustrate the differences between multitasking and multiprocessing. In a multitasking environment, one application (or more) appears in freeze-frame, while another single application is live in another window. With multiprocessing, all of the windows, representing more than one application, are live.

Decreasing memory prices — which encourage the utilization of fixed-disk options — and increasing processor speeds will continue to spur the incorporation of the multitasking capability into desktop computer hardware and software. In addition, the increasing use and availability of 256K-byte microprocessors will encourage the incorporation of multiprocessing capabilities at the desktop computer level.

**Hardware/software requirements:** The hardware and software required to make the integrated software operational varies by package. Those at the higher levels of integration have more specific hardware requirements in terms of processor speed, mass memory and so on. How providers of integrated software address each of these issues illustrates the diversity in the definition of the term "integrated."

Although categorizing can be hazardous, particularly in as fast-paced a market as desktop computer software, the Yankee Group has established four categories of integrated software:

**Decreasing memory prices — which encourage the utilization of fixed-disk options — and increasing processor speeds will continue to spur the incorporation of multitasking into desktop hardware and software.**

- Hardware/software integrateds.
- Software integrators.
- Integrated software.
- Associated software.

**The hardware/software integrateds** are epitomized by Apple's Lisa; their systems (both hardware and software) have an extremely tight, synergistic relationship. In Lisa's case, the operating system is proprietary, and applications that can be performed are limited to those initially provided by the vendor or developed by a third party under license.

In either case, the required adherence to a proprietary operating system means the hardware/software integrateds are essentially closed systems.

Data General Corp. and Honeywell, Inc., with their Desktop Generation Series and Microsystems 6/10 and 6/20 respectively, have sidestepped this problem by splitting their operating environment. Each of these units supports an operating system proprietary to the company and compatible with its minicomputer line. Their software and hardware therefore are highly integrated, which ensures file compatibility at both the desktop level and above, as well as a common user interface throughout the product line.

What opens these systems is that each also supports industry-standard operating systems — CP/M and MS-DOS — that allow the desktop computers to take advantage of vast quantities of available applications software written by third parties.

The advantage to the user of a hardware/software integrated

addition, the safety of single vendor sourcing means that, if something is wrong, only one vendor is to blame. With hardware/software integrated units from minicomputer vendors, the benefits of a coherent family of processing units is also achieved.

Some entry-level desktop computer users not partial to a certain minicomputer family may be confused by the seeming myriad of hardware and software choices. They may adopt the hardware/software integrateds, such as Lisa, as the safest route to desktop computing. However, the desktop computer with only a proprietary operating system might not become a standard with high-volume sales. In that case, vendor software development may lag, and third parties may lose the interest and incentive necessary to develop applications.

The user must be willing to accept the limitations imposed by a restricted set of embedded applications software and be content to wait until the vendor or licensee are ready to provide additional applications he may want.

The hardware/software integrateds provide a multitasking capability; in the case of Lisa, two or more applications can be run concurrently. More than one application can be worked on, each viewed on a single screen in a series of windows. Graphics-based guidance and selection by pointing by means of a mouse are user-interface devices designed to make desktop computer usage easier. These user interfaces were first used in Xerox Corp.'s Star to address the ease-of-use issue. The importance of that issue is evident

these interfaces into the less pricey desktop computers is and will continue to be a result of the greater availability of memory and faster processing.

The use of graphics-based guidance is more advanced in Lisa than in the DG and Honeywell examples. Their strength lies in their file compatibility with other members of their product families, something Lisa fails to provide.

**The software integrators** provide an environment that is at least hardware-independent, unlike the software integrateds, which are tied to hardware and a proprietary operating system. Software integrators function with industry-standard, not proprietary, operating systems — for example, CP/M, MS-DOS and, soon, Xenix for the 8-, 16- and 32-bit processors.

In theory, software integrators can accept an unlimited number of applications packages — possibly from diverse sources — and run them concurrently. Therefore, these software integrators provide an open system in contrast to the software integrateds' closed system.

Windowing capability is a feature the software integrators share with the integrateds. Files are transferable between applications that can be performed concurrently. To varying degrees, the software integrators also provide a common command structure or consistent user interface and are supported by specific hardware requirements. The principal examples of software integrators are Visicorp.'s Vision and Quarterdeck Software's Desq, each of which requires 256K bytes and a rigid disk. These two examples illustrate that, even within the neat yet general category of software integrators, distinctions exist. The distinctions reflect the *raison d'être* of each of the providing companies.

**V**isicorp., of San Jose, Calif., touts Vision as an applications environment, not an operating system. Vision is alleged to be independent of both machine and operating system, sitting on top of the operating system and providing a nesting place for a variety of applications packages to be run concurrently. Initially, it will be offered for the IBM Personal Computer, Wang Laboratories, Inc.'s and Texas Instruments, Inc.'s Professional Computers and one of Digital Equipment Corp.'s desktop computers.

Is Vision open or closed? Theoretically, it is open — applications that can be run under Vision are not limited by the hardware/software configuration, except for memory requirements of each application. However, in order for third-party software vendors to link with Vision, certain Visicorp. specifications must be met. No data transfer is possible between applications without it.

Vision's windowing capability

**The desktop computer with only a proprietary operating system might not become a standard with high-volume sales. In that case, vendor software development may lag, and third parties may lose the interest and incentive necessary to develop applications.**

unit is the guaranteed common command structure and total file compatibility of applications. In

the adoption of these devices by the hardware/software integrators. However, the incorporation of



allows the multiple applications being performed to be visible on one screen concurrently. Its "consistent user interface" uses a mouse and nine English commands. A bar of commands sits at the bottom of the screen, plus commands unique to each application in every window. Initial applications supported are spreadsheet, WP, data management and graphics, all from the Visi-stable of applications packages. VisiCorp. is, after all, in the applications software business. Therefore, the applications of the host house will come up first and will be more synergistically integrated.

Vision was introduced in November 1982, with promises of availability by summer of 1983. Currently, Vision is not expected to ship until at least late fall of this year. In designing Vision as it has, VisiCorp. has attempted to trade on its rather impressive reputation and to consolidate its hold on a huge installed base of Visi applications users. By providing a means of linking all Visi applications together, Vision extends the life of individual single-application packages in an increasingly integrated desktop computer world. The licensing of third-party software vendors (plus provision of development tools and so on) can help to extend the life of existing Visi products by expanding the applications line.

Desq, from Quarterdeck Software, Inc. in Santa Monica, Calif., is a software integrator that uses its lack of a software installed base to its advantage. Instead of trying to protect its past revenue base, Quarterdeck is seeking to be a universal link.

Quarterdeck claims Desq will offer users the ability to integrate their favorite MS-DOS-based off-the-shelf applications packages — regardless of their source — into a common-command, multitasking vehicle. This ambitious plan makes Desq the ultimately open system. Like Vision, Desq allows users proficient in certain applications packages (or from companies that have standardized on certain software formats) to bring that expertise with them into the integrated environment. This means familiar command formats resident in those packages can be used or, with Desq, intercepted by the Desq program and front-ended by a common set of Desq commands. Quarterdeck claims to be able to handle any package that runs under MS-DOS, except those whose performance is somehow tied to actual hardware. According to Gary Pope, Quarterdeck's executive vice-president and founder, the firm has successfully tried about 70 packages in-house.

Desq provides another interesting feature, which results from its "artificial intelligence-like" language, said to be similar to Smalltalk and Lisp. It allows the system to learn functions as performed by the user, to be stored and reused — a sort of program-as-you-

go feature. It allows the system to truly mimic the way a user works. This kind of almost porous software that accepts its program content from the user will be an increasingly important feature of desktop computer software.

Windows and mice are also a feature of the Desq system, but the keyboard can be used equally well.

In terms of hardware requirements, Desq is not much different from Vision. It, too, requires 256K bytes and, minimally, a 5M-

By basing its offerings on a single disk, each of these integrated software packages addresses a major ease-of-use issue. The user is not required to swap diskettes with each application change — a time-consuming and possibly error-prone process, but a necessary one with nonintegrated software. These integrated software packages also offer the advantage that all files are internally compatible and a common command and help structure is provided.

***In the hardware/software integrators, software and hardware are bundled. In the software integrators, the software serves as the integrating repository for a variety of single application packages.***

byte disk. Quarterdeck introduced Desq at Comdex — Spring in Atlanta in April and promised its release for September of this year. Company sources now schedule the release for October — just like Vision.

Of the two announced software integrators, Desq's approach may be the best immediate solution to the complexity of today's desktop computer software market. Its proclaimed ability to support a myriad of products reflects the diversity of currently available software packages and the trouble users now face in integrating them. However, both Desq and Vision still have to prove their merit in actual operation. Questions exist as to how Desq's close to universal approach can retain the nuances of individual packages it supports.

**Integrated Software:** Two currently available integrated software packages meet the criteria assigned to our category of the same name. Their physical integration, common command structures and internally compatible files place these two packages in the category of integrated software.

MBA from Context Management Systems, Inc. (Torrance, Calif.) and 1-2-3 from Lotus Development Corp. (Cambridge, Mass.) offer a given set of applications resident on a single disk. This differs from examples of the two previous groups: In the hardware/software integrators, software and hardware are bundled; in the software integrators, the software offering serves as the integrating repository for a variety of single application packages.

**H**owever, the software that is available to the user is limited in this type of system to a given set. Therefore, although one of the criteria for desktop computer product purchase — ease of use — is met, the other — software availability — is not addressed.

Priced at \$695, MBA offers spreadsheet, graphics, data management and some WP (8,000 characters). At \$495, 1-2-3's principal application is spreadsheet, which is enhanced with graphics and limited data management capabilities. The 1-2-3 WP is basically nonexistent and will be added later this year. Given the fact that WP closely follows spreadsheet as the second most frequently performed application, this capability is a necessity. Because the applications set is limited in both cases, these integrated software vendors provide closed systems.

Both integrated software packages are seeking to make their offerings, if not open, at least less closed. Lotus in particular is working to connect 1-2-3 to the outside world — to the service bureau offerings of ADP Network Services via ADP's Datapath and to corporate mainframes through its relationship with McCormack & Dodge Corp.'s Interactive PC. In both cases, data resident elsewhere can be downloaded into 1-2-3 at the desktop level, manipulated and uploaded, without reformatting.

Although both MBA and 1-2-3 are single-disk-based, closed applications systems using internally consistent user interfaces, some significant differences do

exist. Under MBA, applications are performed concurrently and can be viewed simultaneously in a series of windows. Lotus' 1-2-3 performs its applications serially and does not use windows, although it is very easy to switch between spreadsheet and graph.

The multitasking vs. single-tasking approaches manifest themselves in different hardware requirements. MBA requires 256K bytes; 1-2-3 requires only 128K (Release 1A, which is compatible with the IBM PC-XT and several other computers and peripherals requires 192K). Both require two double-sided disk drives.

Both of these packages are mouse-free and rely on keyboard commands, mnemonics and highlighting for commands. Both come with tutorial/demonstration disks.

**Associated Software:** Associated software is the final form of the so-called integrated software discussed here. The term "associated" reflects the loose degree of applications integration provided by package vendors. As with previously categorized offerings, some applications are more closely associated than others.

High-end associated software is defined as a series of individual applications packages (usually from the same vendor) that share a common user interface. In addition, a common file structure allows the transference of data between applications that run either serially or concurrently. Low-end associated software can be defined as a series of applications packages — again, usually from a single vendor — that share file compatibility potential, which can be loosed through a utility program.

Microsoft Corp.'s Multi-Tool expert systems will probably be the most closely related high-end as-

***Each type of integrated software provides utility for the broad spectrum of desktop computer users today.***

sociated software offerings. Two are currently available. Financial Statement and Budget, and are billed as "powerful additions" to Microsoft's best-selling Multiplan electronic worksheet. Both can run on Apple II, II+ and file with 64K bytes and one disk drive, or under MS-DOS with 128K bytes.

The associated nature of the software provides a file transfer capability and a common com-

mand structure, in an effort to promote follow-on sales to a user base familiar with the applications vendor's general modus operandi. This group consists of users with whom Microsoft has developed a reputation for reliability — a large group, given the prevalence of Apple and MS-DOS-based desktop computers.

Multi-Tool Word is another addition to the Multi-Tool series, with the same hardware requirements. It differs from the previous two in its heavy use of a mouse for selecting and executing commands. An expert level allows the user to abandon the mouse and utilize command keys. This package also provides up to eight windows within its single WP application for viewing a series of documents and moving text among them. Multi-Tool Word can also incorporate printed files from Multiplan and other Multi-Tool application packages.

With its reliance on the mouse, Multi-Tool Word is a step toward an advanced hardware version of other Multi-Tool applications packages. They will most likely be designed to run under a 3.0 version of MS-DOS, providing multitasking capabilities, windowing, mouse cursor control and possibly icon graphics. These features will increase the hardware requirements, no doubt to include 256K bytes and a hard disk.

Each type of integrated software discussed provides utility for the broad spectrum of desktop computer users today. None of them may prove to be long-term solutions for integrated desktop computer applications. Based as it is on a prevalent, industry-standard operating system and providing a compatibility and a common interface for a large number of diverse applications packages, Desq may be the short-term solution to software integration. This could be true particularly in cases of user proficiency or some substantial user investment in diverse software, according to the Yankee Group.

For the long term, two of the abovementioned types, reflecting different market populations, may have greater success. In larger organizations, certain hardware/software integrations may provide the best solution. These are the hardware/software integrations that combine a proprietary operating system with an industry-standard operating system, thereby providing file compatibility, common user interface and a large amount of available software at and above the desktop processing level. Examples are Data General, Honeywell and, before too long, IBM.

Hardware/software integrations without a bridge between their proprietary operating system and

the industry standards or an additional processing level to communicate with will find themselves with a dearth of applications software. For this reason, Apple may elect to support MS-DOS with Lisa before the end of 1983.

For smaller organizations where requirements for communications to internal mainframes and minis is not an issue, the software integrations may provide the best solution. The software integrations could provide a core applications package — spreadsheet, WP, graphics, data management — with a receptacle for an industry-specific applications package. These packages would be written by third parties, to be loaded in by the user. In addition, links to outside data bases such as those being pursued by 1-2-3 could provide access to additional data. Again, a common command and help structure would be provided and file compatibility ensured.

In both cases, how successfully the issues of user interface, help and file compatibility are addressed will determine the market success of the integrated software. QA

---

*Carr is a consultant at the Yankee Group, a consulting firm based in Boston.*



## Fourth-Generation Languages

By Henry T. Cochran

These tools bring self-sufficiency to end users and guide them in becoming responsible for the development and maintenance of their own tasks.

One management information systems (MIS) manager described his department's philosophy this way: "We give our users the tools and guidance they need to automate their own solutions. They can create exactly what they need at the time it's required. If needed, we're available with the assistance and guidance they may need to be successful." With experience, business users become adept at using the computer as a tool to solve tactical and strategic problems, and DP staffs can focus attention on the operational problems of the corporation.

In addition, the latest wave of personal computer products has dramatically influenced what managers and professionals have come to expect from their computer resource. For the business user who has experienced the frustration of waiting in the DP backlog queue, the promise of these new tools that solve problems at a more individualized level and with a minimum of effort has great appeal. Management is no longer interested in the computer solely for its role in handling conventional operational tasks such as payroll, accounts receivable, purchasing and order entry. Now it is seen as a management tool for identifying and analyzing long-term trends and issues of strategic importance to the business.

There are several ways of personalizing the computer. Obviously, one can use a personal computer. Personal applications, such as the many spreadsheet systems, are also available today. These options are the best known because of the newness of the technology and the resulting media interest in the explosive

growth of this new marketplace.

Perhaps less well known but equally powerful are the fourth-generation personal computing languages. These general-purpose software tools are easily applied on a larger organizational scale to accomplish the same personalized approach to solving individual and departmental problems.

Originally offered in the mid-1970's, fourth-generation languages have recently come into their own, often accompanying data management systems. Many also have links to related special-purpose functions, such as word processing, document retrieval and financial modeling. With these integrated fourth-generation language systems, the user has ready access to multiple functions on a single hardware system and does not have to be concerned with loading on new software for each operation.

Fourth-generation languages are appealing for a number of reasons. They incorporate familiar English commands that are easy to understand and to apply. The commands are powerful: A few words accomplish complete tasks, for example, designing a file (DEFINE), adding data (ADD), locating information based on very specific criteria (RESELECT FOR) or printing a report (REPORT). With one day of training, computer novices can implement a complete application from describing the data file, designing a unique formatted data entry screen, to writing special reports. On the other hand, systems analysts can prototype and test an entire application in less time than would be spent on the system specification using conventional methods.

Fourth-generation languages provide tremendous flexibility. Focused departmental applications are quickly developed to accomplish a single purpose, as in establishing an order flow tracking system. This system, or elements of it, can easily be linked or

**T**raditional roles of data processing and business professionals are being revolutionized. Business users are increasingly asking for automation to simplify department management, development of business plans and scheduling of personal activities. In response, the computer professional is becoming less of a project design specialist and more of a consultant in grooming the business professional for computer self-sufficiency. These new relationships mark a healthy spirit of cooperation among key corporate resources, and that in turn has led to the emergence of the information management center, the personal computer and fourth-generation languages as resource facilities for companies.

merged with selected information in production, purchasing and billing systems. When internal resources are combined in this manner, each department or individual becomes responsible for the information it references or acts upon, rather than for an entire system. The focus is on the specific business problem or activity, not on the preparation and manipulation of data. As a result, users of these languages feel comfortable with the computer as a tool to solve their own problems.

DP departments have found that fourth-generation languages enable them to provide faster response to their user departments, particularly in handling ad hoc queries and reports. These are often time-sensitive requests for summary reports or minor changes to standard reports; they may look like simple cosmetic changes, but they typically require a fair amount of system staff time to format or reprogram. With the fourth-generation languages, end users can easily collect and print only the information they need. When end users are able to handle these requests themselves, applications backlogs are reduced dramatically and the DP professionals can focus their expertise on larger applications.

The advent of personal computing languages has given DP professionals and business end users a choice of tools for a given application. Personal computing languages are preferable under the following conditions:

- Quick application implementation is key.
- It's a one-time request.
- Modifications to the application are anticipated.
- Leverage through integrated tools such as business graphics or word processing is desirable.
- Local control and maintenance is preferred.

For a personal computing tool to be an effective end-user support resource, it must contain

some key features. Ease of use is most important. The language must be as comfortable and clear to use as English. Ease of use also extends to the ability to create a file and perform simple data entry. More complex data entry, aided by formatted screens, editing and data manipulation is also important to ensure that information is entered accurately.

Another key criterion is the ability to reference a file and quickly produce reports that incorporate specific information and calculations. And, while relational data management may not mean much to an end user, it is an important consideration; it allows that user to extract information from multiple file sources and to build a customized view of a problem. Relational data structures replicate traditional manual systems and allow the user to concentrate on results, not data.

How is the fourth-generation language integrated into the modern business entity? Based on the type of business, the computing resource may be centralized and managed exclusively by the DP department or distributed to users. Applications development may also be handled completely by MIS or by the end user. Often it is a combination of the two. The personal computing phenomenon is clearly stimulating the move toward the localized use of the resource and increased end-user responsibility for applications development.

Overall, we can identify four common computing environments: traditional centralized computing, departmental systems, OA and personal computing. The first two are classical examples of computer use within organizations. OA and personal computing are new implementations, often discussed but still in the process of formal definition.

Traditional computing is most familiar because it has been used longest. Here, the computer re-



source is centralized in one self-contained department that handles all the computing requirements of the entire organization. In this environment, the fourth-generation language is used both as a prototyping tool for designing and testing complete application systems and as an applications development tool used by programmers and analysts to design and maintain departmental level applications. With fourth-generation languages, projects are complete and ready to use in one-quarter to one-tenth the time required by conventional methods.

Departmental systems are a variation of the centralized computing theme. Local departments have their own computing resource for managing local information requirements. In many companies, departments have use of a dedicated minicomputer for this purpose; in others, many departments share a common company system. Fourth-generation languages expedite the design and

implementation of systems to automate departmental activities and give the administrative and professional users basic tools for self-sufficiency in data entry, file inquiries and customized reporting. The centralized DP resource carries on the design and maintenance of key operational applications and is available to the department as a technical resource for problem resolution.

In OA and personal computing, the computing tools (terminals and software) are applied purely at the discretion of the individual or department. Many organizations are tending to overlap or merge these two departments.

In OA, the focus is twofold. The most common use is to enhance the productivity of secretarial and administrative staff in preparing and handling documents. However, OA tools like text management and document retrieval systems also enhance the decision-making effectiveness of managerial and professional

staff. Fourth-generation language systems with their inherent data management capabilities have been linked with word processors, text management systems and document retrieval systems to satisfy the requirements of these office professionals.

**P**ersonal computing, the fourth environment, is entirely subjective. The purpose of the personal computing tool — the computer, the computing software system or the computing language — is to equip the user to define a problem in his own terms and summon the resources of the computer to solve that problem. Used in this way, the fourth-generation language and integrated software tools for data management, business planning, business graphics and document retrieval can be applied to improve managerial insight and effectiveness at a highly individ-

ualized level.

Regardless of the computing environment and management orientation, the fourth-generation language is the one tool that can be integrated at all levels.

Today, ease-of-use fourth-generation language systems link word processing, financial modeling and business graphics with data and text management and even with specialized departmental applications. This new ability to combine information management resources with special-purpose tools has made possible new and better ways to handle tedious and cumbersome manual processes and to gain insight for problem solving. Professionals can now use electronic filing and retrieval systems for access to documents for litigation support or competitive research. Data and text management systems can be used for producing an analysis of a budget vs. actual incorporating variance explanation. Business planning systems can be linked to informa-

## FOCUS

tion management for cost estimating and sales analysis.

**A**s powerful and productive as the fourth-generation language systems have been in responding to the demands of the personal computing revolution, they are not the final answer. Products able to respond to a broad range of application requirements today — from data management, to OA, to financial modeling — are still in the evolutionary state, the result of linking several separate products.

The ideal is a single complete product specifically designed to accommodate all the computing needs of the business professional with one consistent user interface. A

single product that runs on the personal micro, the departmental mini and the corporate mainframe is the key concept. By this definition, the true fifth-generation language cannot be an adaptation of systems available today.

The fifth-generation language systems now in development promise to be a completely new class of product and are destined to redefine the concept of user-friendly. We'll see a much higher level user interface than is currently available, with new features that combine the best of today's hardware and software products. They will be self-prompted systems requiring only a cursory orientation and minimal training because of their close similarity to conversational English and the extensive refer-

ence cues embedded in the user interface. The working screen may be split into multiple windows to allow several processes to be monitored at one time. Multiple functions will work simultaneously so documents can be prepared with text, charts and models, "cutting and pasting" on-line.

At a minimum, the fifth-generation language will combine data management, business graphics, WP, free-text retrieval, spreadsheet analysis and electronic mail. They will also incorporate the best of communications and networking technologies to expedite corporate-wide sharing of information, regardless of the geographic location of the business facility. All the mechanics of the transfers will be transparent to the user.

The fifth-generation language will be cross-compatible with the operating systems of all major computer systems — mainframe, minicomputer and microcomputer. Information will be able to be accessed for individualized problem solving, regardless of where it is located.

The ultimate objective of the fifth-generation system is to make the computer terminal as comfortable as a business tool as the desk, where business documents are always within reach — to be touched, read and filed. And working with that information will become as easy as wielding a pen.

As dramatic as these concepts may sound today, the new generation is clearly in sight. In fact, elements of it are already available. Windowed

screens, pointers to symbolic pictures and touch-sensitive screens are here today. Software products are beginning to merge multiple functions into one package.

These are key events on the way to the final solution — one product, with relational data management at the core, a single consistent user interface, compatibility with common operating systems from micro to mainframe and networked for information sharing on a global perspective. This solution will provide truly integrated software systems for decision support. **OA**

Cochran is president of Henco Software, Inc., a software firm in Waltham, Mass.



## 7. INTERCONNECTION

# Communicating with A Mainframe

**P**eople in business are beginning to appreciate that technological co-existence between computers of different sizes and capabilities is becoming easier to achieve. Underlying this is the awareness that teaming a personal computer with its big mainframe brother can be very useful. Such a partnership allows for more efficient use of both computers. The hefty mainframes can concentrate on large, unwieldy jobs—number crunching and dealing with huge databases—and the personal computer can handle the lesser tasks.

While a personal computer user might have any number of good reasons for tying in with a mainframe, the following advantages are most often cited:

- **Program or data transfer.** Because mainframes are more powerful, it's sometimes easier to prepare data on a personal computer and then copy it to a mainframe for programming work. If you have an IBM 370 at your office and an Apple at home, you can take a project home in the evening for review and then put it in the mainframe in the morning to continue working on it.
- **Resource sharing.** With access to a mainframe, a computer user can typically use high-speed printers and plotters for creating hard copy. In addition, mainframes usually have some kind of archiving facility so data can be stored easily and reliably for an extended period of time. This particular safeguard reduces the burden of making backup copies with your own personal computer. Another benefit of resource sharing is that information stored in a mainframe is accessible to any number of people who might need it.
- **Remote computing.** While you're away from the mainframe location, the personal computer can be used

to prepare commands and input data for the larger machine. Thus, a manager with a number of salespeople in the field might give each one a personal computer to input records and prepare figures and then consolidate all the information from a given territory in the mainframe.

- **Remote-user capability.** Using telephone interfaces, personal computers can function as though they were native terminals for larger systems. The capability for remote use can tie the personal computer to a public subscription service for stock market updates, news, travel reservations, bill paying, shopping, and more. Programs can also be run on the service's computers, and its databases can be used for information storage.

- **Database access.** There are numerous private and public special-interest databases on larger systems that can be accessed by a microcomputer. Whether they're from your company's library or a pay-by-the-hour service, these larger databases effectively enlarge the world your personal computer is privy to.

- **Mail services.** Many mainframes with online services have mail systems that allow users to read messages from senders who may be in another office down the hall or around the world. A personal computer user would have access to the mail system from his or her home and be able to receive and transmit replies from the comfort of a living room.

So how do you talk to a mainframe? By far the most popular method of connecting with a heavy-weight is the modem. Modems are commercially available from computer stores and range in price from \$100 to \$1000 depending on transmission speed, features, and immunity to telephone-line noise.

Modems let personal computer users be geographically independent, but because popular modems are generally limited to no more than 120 characters per second, transmission of large amounts of data may be too slow.

If you use your personal computer at work, it's possible to run direct lines from it to the mainframe. Your computer specialists will probably connect the two using an RS-232C (or RS-422) interface to a port on the mainframe. Because each line takes up a port of its own, however, the connection can be quite inefficient and expensive unless you put in at least four solid hours of use per day.

A more efficient way to connect to a mainframe is with a local network (sometimes called a local area network or LAN). Such a network can concentrate many users and sometimes other equipment such as printers into one special high-capacity port. Xerox's Ethernet and Datapoint's ARCnet are two local networks that have often been used to establish communications between mainframes and microcomputers. Local networks are in their infancy and admittedly still have substantial standards problems that need to be overcome before they reach their full potential. Some custom engineering is usually required for each installation.

Most connections with mainframes also require special software. The connection that you do establish is only as good as the software program that tells your computer how, when, and where to look for or send data. Because most personal computers come with an RS-232C port installed, you shouldn't need special hardware for your machine.

If you work with a mainframe and are interested in hooking up a microcomputer, talk to your data-processing personnel. If you're interested in linking to a public subscription service, your computer dealer should be able to give you more information.

—Mark Levine and Joel Williams



# Finding a Proper Translation

How to exchange information between different computers without re-entering all the data? Some surprising solutions are available for this nagging business dilemma.

By Amy E. Smith

Anne D., of Acme Inc., got an Apple computer several years ago for word processing and spreadsheet applications. This worked fine until last year, when Acme yielded to the microcomputer invasion and purchased several dozen IBM PC's for its employees, including Anne D. Anne was faced with somehow getting all her old files into her new computer, a problem compounded by the fact that both machines were entirely different in terms of hardware and operating systems.

Anne's husband, Steve, faced a similar problem in his job as a corporate accountant. His department had a CP/M multiuser system. The people in sales, however, had 16-bit MSDOS systems. When Steve and his staff requested information from sales, it had to be printed out because the CP/M computer couldn't read MSDOS diskettes. Steve's secretary often ended up entering all that information into the department's computer.

If these situations sound familiar, they should. They're on the rise these days in many businesses. People now are increasingly faced with the problem of trying to get two different computer systems to exchange information, usually because they are upgrading to a new system or because they have to share information with someone who has a different type of computer. While users often feel they have no other choice but to re-enter everything, there are some solutions available.

Users have to surmount three types of translation problems: exchanging data files, exchanging programs and transporting data on differently formatted diskettes. The difficulty of overcoming each problem varies with the type of computer — whether microcomputer or mainframe — under consideration and the method that one attempts to use to deal with the situation.

Most microcomputers have common communications protocols and codes that enable them to exchange information fairly easily. For instance, microcomputers

tend to utilize ASCII (American Standard Code for Information Interchange) for encoding data. ASCII code includes alphanumeric characters as well as some standard typing commands like tab and carriage return. Thus, according to Jack Bader, vice president of The User Group, St. Louis, Mo., a data-processing consulting firm, an ASCII file sent from one microcomputer to another can probably be read by the receiving computer with little problem.

The crux of the problem is getting the files from one computer to another. By far the most popular method of doing this is to literally phone it in. Modems and special communications software, like Crosstalk from Microstuf, Atlanta, Ga., and BSTAM, from Lifeboat Associates, New York, N.Y., are required at both the sending and receiving ends. One user dials up the other computer via the modem, and the communications software enables the computers to exchange files.

One of the most popular communications software packages, Modem 7, is free. A "public domain" program, Modem 7 is generally available from CP/M user groups. A computer user with Modem 7 on his computer can communicate with any other computer that uses Modem 7. Modem 7 is also widely used for downloading (sending data from a larger system to a smaller one) and uploading (sending data from a smaller system to a larger one) software to and from computer bulletin boards.

A problem often encountered with this method, however, is ensuring that all of the file comes over the line. "Errors creep in because you're dealing with Ma Bell," says Jack Bader. "If a lineman jiggles the wires, you'll probably lose bits." To avoid this, many communications software packages include error detection and correction — a method of double checking that the information leaving the computer is intact upon its arrival at the other. If the data does not arrive complete, it is retransmitted until its integrity is confirmed.

A word about text formatting commands used in data files: most of these are control characters (e.g. PB in WordStar, the command for boldface print) and vary

---

*Amy E. Smith is a staff writer for Business Computer Systems.*

BUSINESS COMPUTER SYSTEMS/SEPTEMBER 1983

*"Finding a Proper Translation", Amy E. Smith, Business Computer Systems, September 1983, pages 86,88-90. Reprinted by permission. Copyright (c) by Connors Publishing Company, Division of Reed Holdings Inc. ALL RIGHTS RESERVED.*



with software. Therefore, text formatting commands may not be recognized with the rest of the file. If the receiving computer runs the same word processing software originally used to format the file, then the commands may be recognized also.

Users don't have to worry about receiving a total jumble of characters, however. Remember, carriage returns, spacing and tabbing are all printable ASCII characters, meaning that they are standard code sequences and would be sent with the file.

### Bank on it

Users also can take advantage of public data banks as aids for exchanging files with other computers. Some data banks, like The Source or CompuServe, provide storage areas and limited translation capabilities for subscribers. To use such storage space, users call the data bank via a modem and deposit the files to be sent to another computer. Later, the files are downloaded in a form that the receiving computer can use.

If two computers are located near one another, they can take advantage of common serial communications protocols by being directly connected via their RS232 ports, rather than using modems (and therefore costly telephone line time). Three lines are wired — ground, transmit and receive — and data communications software is used at either end. Connecting computers this way often eliminates the problems inherent in telecom-

## Public data banks like the Source and CompuServe offer users a way to exchange files with other computers.

munications, such as data loss. Communications through RS232 ports also is faster than that over phone lines — up to 19,200 bits per second versus 300 to 1200 bps for most common modems.

### Tight-lipped

Getting larger systems like mini-computers and mainframes to exchange information with each other or microcomputers can be more difficult. Larger systems often use non-ASCII code sequences, for example, IBM's EBCDIC (Extended Binary Coded Decimal Interchange Code). Even if microcomputer users can get a file from the mainframe, the computer won't be able to read the file because it can't read the encoded data.

Some companies make and sell devices that enable ASCII and non-ASCII computers to exchange information. One company, Affiliated Concepts Inc., Santa Barbara, Calif., accomplishes this through a type of media conversion — from magnetic tape used as back-up media on larger computers to microcomputer diskettes. According to Dominic Camardella, vice president of marketing for Affiliated Concepts, Affiliated's Tapexchg converts non-ASCII files on mainframe magnetic tape to ASCII code on a diskette for S-100 microcomputer systems. The Tapexchg system consists of software and a circuit board that plugs into the computer. All that is needed is a tape drive connected to the microcomputer.

Another company, Nuf Computer Co., Newton Upper Falls, Mass., makes a similar product to convert both tape and disk media formats into disks for the Xerox 820 microcomputer. Nuf president John Marlin points out one of the device's main advantages: "It's simpler, and politically more astute, to be able to take magnetic tape off the mainframe and get data files that way, instead of dropping 3270 ports (gateways from remote terminals to mainframes) into an office or department. It's also easier for EDP operators to simply hand you magnetic tape when you request data; they'd rather not be bothered trying to get it to disk."

### Cracking the code

Getting a program that runs on one type of computer to run on a different one is more difficult, legally and logistically. Depending on the owner's software licensing agreement, it may be against the law to copy commercial software,

like VisiCalc or WordStar, for use on other computers. However, users often have programs they've written themselves on one system that they wish to use on another; while this is not outside the law, it is trickier logistically.

A computer program has two kinds of codes. The source code, or English-like programming languages like FORTRAN, BASIC, or COBOL, is fairly similar on all computers. Object code is the machine language the computer understands and is specific to a microprocessor. The source code is reduced to object code, with the help of intermediary software known as compilers and assemblers.

The compilation process is processor specific, Jack Bader points out. "A CP/M compiler will be different from one used on an IBM PC or Wang Professional Computer, because the object codes of all those machines differ. Source codes have to be compiled to two different object codes on different processors."

The recommended method for translating a program from one computer to the other is to treat the source code as a data file. The "data file" is sent, like any other data file, to the receiving computer via telecommunications or by directly loading a diskette. Once the file arrives, the user recompiles it to the object code for the new computer. At this point, the program is in fairly good shape to be used by the new computer, although it may have to be debugged to some extent.

Translation of programs can't be done as universally as for data files because object codes vary. A program written for a Z80-based, CP/M computer won't run on an IBM PC. Programs can be translated between computers with the same processor, however. A Z80-based Intertec SuperBrain computer can probably run a program for a TeleVideo computer.

Another translation dilemma users face is moving data between differently formatted diskettes. Unlike the IBM standard format on 8-inch floppies, 5¼-inch diskette formats vary widely. For example, it's not possible to take a disk from a CP/M machine, pop it into an MSDOS microcomputer, and expect it to work. However, it is possible to



convert data on diskettes formatted one way so that they can be read by another computer.

### Staying on track

Format is the manner in which data is arranged on a diskette, and it varies with the type of computer and drive used. Some formatting characteristics, such as track density, sectoring, and whether diskettes are single-sided or double-sided, depend on the drive. Some drives only read double-sided, soft-sectored disks with a track density of 96 tracks per inch. Others can only use single-sided, hard-sectored diskettes with 48 tracks per inch.

Tracks are circular areas on a diskette. They are divided into sectors, the number of which

hold information, one in the form of data bits, the other in the form of books. And both have directory information identifying the data they hold.

The varying formats used among different computers are just different ways of arranging the bookshelves. The Boston Public Library's books on antique cars may be on the third floor, while the similar collection in the Kankakee Public Library may be on the first floor.

### Format to format

There are software packages that convert data from one diskette format to that of another. René Vishney, founder of Award Software Inc., Los Gatos, Calif., developed one such package — Crossdata. Vishney cites speed and convenience as the chief advantages of his product. Says Vishney: "The conventional means of exchanging data by telecommunications (a) never works, and when it does, (b) it takes forever."

Crossdata converts MSDOS files on one disk into CP/M format on another, and vice versa. The disks can both be read and written to. All users have to do is load Crossdata into the machine that they want to read the files, put the data disk in along with another disk, and Crossdata does the conversion. Essentially, files are rewritten in the desired format.

Moreover, Crossdata converts data of either operating system into the other's format, and back. Say a person has a CP/M computer at the office and an IBM-compatible portable at home. He could bring home work on a CP/M disk, and convert it to MSDOS so his portable microcomputer could read it. The files can then be brought back to the office the next day and converted back to CP/M.

With Crossdata, Vishney says that programs can be translated at source code level from one format to the other. Crossdata also translates formatting commands. A WordStar file with all its formatting commands can be converted just as it's written.

Wintex Computer Corp., Schaumburg, Ill., markets a package for CP/M to iRMX-86 conversions. Like Crossdata, any files —

text files and source code — can be converted, but once converted, the file cannot be changed back with the Wintex utility.

VDisk, a software package from Compuvision Products Inc., Ann Arbor, Mich., enables an IBM PC to format, read and write to more than 20 disk formats, such as Altos, Digilog, Eagle II and Osborne. Not only can a blank diskette be formatted for use on the target computer, but with VDisk the PC can read and write to the disk.

A "black box" called the Pirate that supports 38 different CP/M disk formats and converts a diskette from one format to another is available from Advanced Consumer Technologies, San Diego, Calif. The Pirate consists of an 8-inch drive and two 5¼-inch drives. According to Stan Tomlinson, a senior consultant with Advanced Consumer, users instruct the drives, with special software, to read and write in desired formats. Users can then switch files from one disk to the other. Furthermore, Tomlinson says, the Pirate makes verbatim copies of files — there are no alterations, and formatting commands are transferred.

Allenbach Industries, Carlsbad, Calif., also has a system that transfers files among CP/M formats, as well as PC DOS and MSDOS. Allenbach does not sell it, however, but does the conversions for customers.

"We were formerly just a software duplicator," says Allenbach president Phil Kessler.

### A California firm will transfer files from one format to another for about \$100 a disk.

"A lot of our CP/M customers wanted to hit a broader market. They wanted to put their software on an Osborne or TeleVideo, for example. So we undertook to convert and duplicate software for as broad a computer base as possible."

Allenbach limits software and file conversion primarily to customers who want to duplicate their

**It's not possible to take a disk from a CP/M machine, pop it into an MSDOS microcomputer and expect it to work.**

depends on whether the diskette is hard- or soft-sectored. Hard-sectored diskettes have a fixed number of sectors, each indexed with a minute hole in the diskette's surface. The number of sectors on soft-sectored diskettes is determined when the diskette is formatted by the operating system, as is the identifying information used to mark the beginning and end of each sector and things like pause and timing information.

For a diskette to be read by a computer, the diskette first has to be physically compatible with the disk drive. This doesn't make for complete compatibility, however. IBM PCs and Osborne Is use 40 track, soft-sectored diskettes, yet neither machine can read the other's diskettes.

The bottom line, then, is how the system formats the disk. Operating systems differ in the way they arrange sectors on the disk to hold data, and the coded information used to identify data contained in each sector. Sectors can be thought of as bookshelves in a library. Both

software and large end users such as banks. Despite a cost of \$100 per diskette, Kessler explains that it is entirely cost effective. "Consider what you'd pay someone to key in all that data, not to mention the cost of computer time."

Sending software and files out for translation may be the best solution for a large corporation with a lot to convert. Conversions can be done quickly and accurately by people who have the right equipment and know what they're doing.

Who does these conversions? There are specialized software conversion houses, like Allenbach Industries. WBG Inc., McLean, Va., is another software conversion company. According to Richard G. Harrison, president, WBG would take about two weeks to convert the largest data base anyone is likely to put on a microcomputer for about \$5,000 to \$6,000.

#### A matter of survival

Dedicated word processors, like Wang office systems or Lanier systems, often pose a special translation problem, because each system utilizes different formatting commands. Word processor files can

also be sent out to word processing service bureaus and typesetters for conversion.

"It's a matter of survival," says Dana Pekunece, a salesman for Altext Inc., a word processing service bureau in Boston, Mass. "Incompatibility among systems is a major problem among typesetting firms, because they're often faced with the problem of putting a Lanier or Wang disk on a Compu-graphic typesetting system that can't read them."

"Survival" usually means developing systems that will convert word processing and typesetting system diskettes. Altext, for example, offers its disk reader for lease or sale. The disk reader supports 12 different systems. Users can put in an 8-inch Wang floppy disk and have the files converted to a Lanier or Compu-graphic diskette.

Itek Composition Systems, Nashua, N.H., claims that its Converter translates disk formats among about 20 models of word processors and microcomputers. It is sold primarily to word processing equipment vendors as a selling tool. If

potential customers are reluctant to implement a new system because of the conversion problems involved, vendors can offer a ready conversion service.

Perhaps the ultimate solution to any translation problem is one offered by Shaffstall Systems Co., Indianapolis, Ind. Shaffstall sells customized hardware-software interfaces that allow transmission of data from a disk in any system to any other system over serial communications lines. According to president Timothy Shaffstall, the interfaces accept data, translate communications protocols (for example, IBM's SNA/SDLC to RS232 handshaking protocols) and convert formatting codes. Users can transmit converted data directly to another machine or produce a floppy disk compatible with the receiving machine.

Translation problems are not totally without solution — there are ways to get information from one computer to another. The solutions, however, are often costly and difficult to implement. For now the brunt of the problem has to be borne by users. ■



# Part One

# A PRIMER ON NETWORKING

*The following is the first in a series of articles excerpted from the book Communications and Networking for the IBM PC, by Larry Jordan and Bruce Churchill, to be published this month by the Robert J. Brady Co.*

Local area networking is a term that describes a form of computer communications generally used to transfer data internally in an organization. Internally, in this context, means within the confines of an office, a group of offices, a building, or a closely spaced group of buildings.

In its most elementary physical form, a local area network (LAN) is two or more computers connected together by some type of wire or cable; the wire or cable forms a data path between the computers. Once established, a local area network allows the exchange of program and data files among users connected to it. Such a network also allows users to send files to a printer or a hard disk attached either to another computer or directly to the network.

What benefits do local area networks offer for business applications?

First, local area networks allow the sharing of expensive resources—such as letter-quality printers and high-capacity hard disk drives. Second, local area networks allow the high-speed exchange of essential information between key people in an organization. If properly done, this sharing promotes greater efficiency and productivity and leads to more sophisticated computer applications, such as electronic mail. Finally, local area networks act as a catalyst to increase the range of potential applications for the personal computer.

Figure 1 illustrates a simple local area network. The printer and hard disk are shared resources, since all of the users have access to them. The hard disk in this example is attached to the network as a separate device through an interface box, it's also possible to attach the hard disk directly to one of the personal computers, just the way the printer is attached in figure 1

*by Bruce Churchill*

## BASIC LOCAL AREA NETWORK

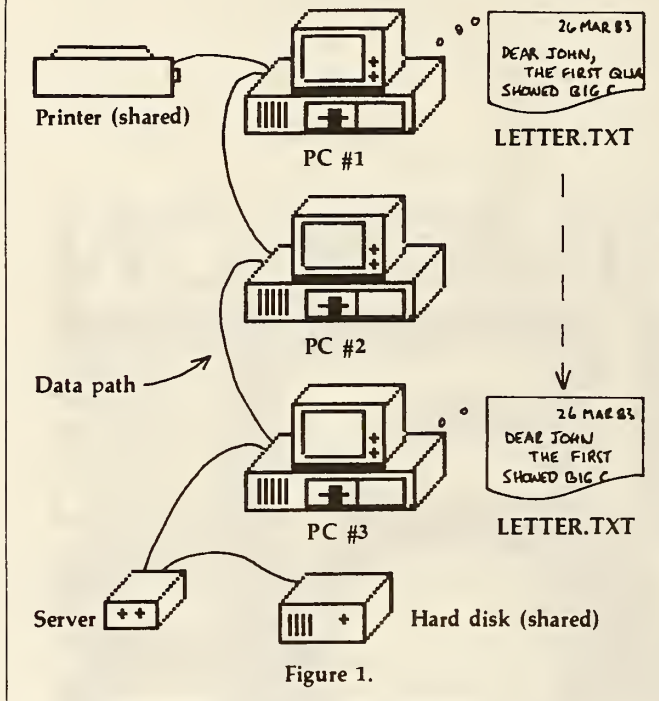


Figure 1.

## BASIC LOCAL AREA NETWORK

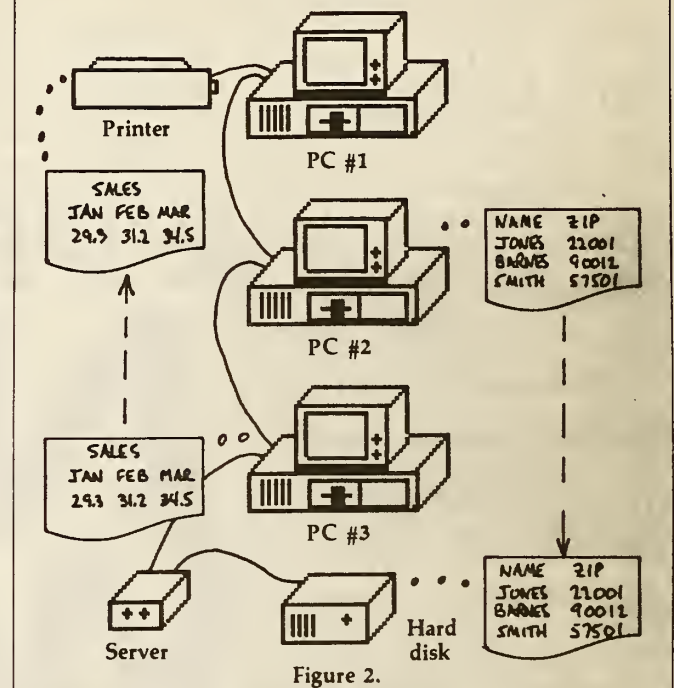


Figure 2.

Figures 1 and 2 show two types of logical processes that may occur in a local area network. Figure 1 depicts a user at pc #1 sending a word processor file to a user at pc #3. This file transfer could have been initiated by either user. The user at pc #3 can interact with the file as if it had originated at his own pc; he can, for example, write the file to a local floppy disk or use it as input to a word processor.

Figure 2 shows a user on pc #3 printing a file at the printer attached to pc #1. It also shows a user on pc #2 storing a locally created file on the remotely connected hard disk. An interesting consideration relating to pc #1 in figure 2 is the degree to which network software will allow that computer to support a local user and at the same time control access to its attached printer. We'll return to this subject later.

**Theme and Variations.** There are two ways to look at a local area network: as communications technology and as a multiuser computer installation. Before we go further in our discussion of LAN fundamentals, it would be useful to characterize LANs in the context of other communications systems and other types of multiuser data-processing systems.

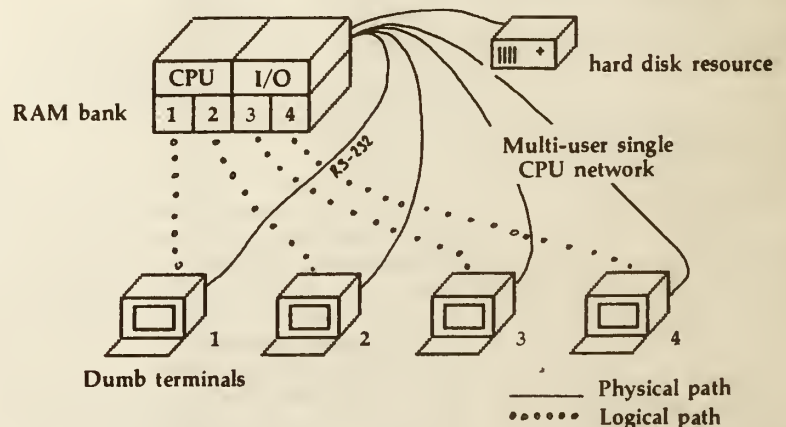
Two primary characteristics of LANs distinguish them from modem networks, such as Telenet, Tymnet, Arpanet, and the public telephone system. First, LANs are designed to work in a restricted geographic area, generally limited to thousands of feet or closely spaced building complexes; and

second, LANs operate at relatively high speeds, compared to the typical modem networks currently in use.

LAN data-transfer speeds may be as high as fifty million bits per second (fifty megabits per second), or slightly more than six million characters per second (rates of one to ten million bits per second are more typi-

cal). Compare this to the maximum data-transfer speeds of fifty-six kilobits per second (seven thousand characters per second) for high-grade telephone company digital trunk lines, or the 300/1200 baud (30/120 characters per second) transmission speed typical of most personal computer communication systems. At the higher speeds,

## SHARED RESOURCE ARCHITECTURES



## LOCAL AREA NETWORK

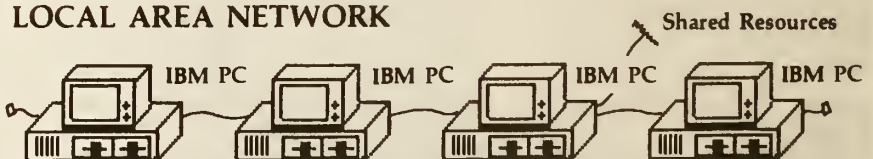


Figure 3.



LANs operate at a rate exceeding that at which many current microprocessors conduct data transfers to and from random access memory.

As multiuser data processing installations, LANs are a logical alternative to the "classic" multiuser system. The latter usually consists of a central processing unit, several terminals connected to the CPU, and a multiuser operating system, such as MP/M-86, Oasis-16, or Xenix. Terminals in a traditional multiuser system are generally not capable of standalone data processing; instead they rely on the central computer to assign a portion of its main memory to, and execute applications for, each terminal's user.

In contrast to the traditional multiuser setup, each workstation in an LAN is an independent, standalone computer, capable of executing its own applications programs. Both types of systems—LAN and traditional multiuser—can reduce peripheral costs by allowing users to share such resources as printers and hard disks.

The physical differences between a single-CPU multiuser system and a local area network are illustrated in figure 3. Terminals on a single-CPU system are physically connected to serial input/output ports on the central computer, and their users are usually assigned specific segments of main memory for program execution and data storage (because these terminals are not standalone computers, they're sometimes called "dumb" terminals). Users in a single-CPU system are typically assigned their own private areas of a shared hard disk for mass storage. (Each user in an LAN may also be assigned private mass-storage space on a hard disk.) The combination of a dumb terminal, its assigned area of main memory, and its share of the CPU execution time is functionally equivalent to a single workstation on a local area network.

**The Basic Components.** Now for some more details about the LAN setup shown in figure 1. Bear in mind that this is a very simple LAN; much more complex ones are possible, but this one illustrates the fundamental concepts.

The hardware components of this network system are three IBM Personal Computers, a printer attached to pc #1, and a hard disk unit. Each pc has an adapter card in one of its peripheral slots; this card goes by a number of different names, depending on which vendor produced it. Some of the more common names for such a card are network adapter card, bus interface unit, and communications interface unit. Whatever its name, this card functions in this network in much the same way that an RS-232 card functions in a modem network.

The network data path is commonly

formed by a coaxial cable similar to that used on a 75-ohm television antenna (one of the two common types of antenna cable). Some systems use a cheaper means of data transport—the twisted-pair wire similar to that used in telephone installations.

The usual method of making connections between each of the pcs and the data path is by means of standard T-connectors on the backs of the adapter cards, as shown in figure 4.

Before we go further, let's stop to assimilate some vocabulary. The pcs and the hard disk interface shown in figure 1 are known as network devices, or nodes. In general, each device or node is connected directly to the network cable, or data path.

The terms transmission medium (plural media) and bus are commonly used synonyms for data path. The word bus appears in other contexts as well; the IBM pc system bus, for example, is the data path by which the 8088 processor communicates with RAM and with I/O devices attached to the pc.

The term server refers to any device that interfaces a non- or semi-intelligent peripheral to the network. The most common of these devices are disk servers (also known as file servers), print servers, and modem servers (also known as communications servers). And, as mentioned before, the IBM pcs included in an LAN are commonly called workstations, particularly in an office automation context.

The body of rules allowing an orderly, reliable transfer of data among all the network devices is known as a protocol.

The terms transparent and virtual are often used in discussions of local area networks. A process is transparent if it exists but does not appear to; a process is virtual if it doesn't exist but appears to. For example, a virtual memory process writes text to a floppy drive when the RAM text buffer overflows; a word processor operator enjoying the use of virtual memory may not know when internal memory has been used up. Another use for the term virtual is illustrated by the single-CPU multiuser installation shown in figure 2. That combination of terminal, RAM segment, and CPU time slice for a single user forms a virtual workstation.

LAN data movement is a good example of transparency: It obviously occurs, but how it occurs is not apparent to the LAN user.

The term throughput refers to a measure that describes the quantity of useful data that can be moved by a local area network in a given time interval. Contrast this with the term data rate, which merely means the rate of speed at which data moves on a network.

The term multiuser, in this discussion,

## LOCAL AREA NETWORK HARDWARE (Typical)

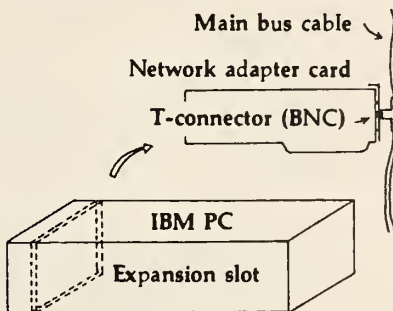


Figure 4.

refers to configurations of several users sharing a common CPU, central memory, and set of I/O devices. The term could, of course, also describe a local area network, but we'll restrict its meaning here in order to distinguish single-CPU setups from LANs.

Multitasking is the sharing of a single CPU by more than one process; the term concurrent is sometimes used as a synonym for multitasking.

One more term: direct memory access (DMA). This is an important concept, because direct memory access is commonly used in local area networks. Simply stated, direct memory access allows input/output devices to conduct data transfers directly to RAM, without CPU intervention. In the context of local area networks, the I/O device is the pc's network adapter card, which contains the logic chips necessary to conduct DMA data transfers. DMA is a prerequisite for the high-speed operations typical of local area networks.

**High-Speed Data Movement.** One of the major factors characterizing local area networks, as you already know, is the speed at which data moves on the network. Table 1 contrasts the speed of a one megabit per second LAN with speeds of other forms of data movement to and from, or within, an IBM pc. The important thing to notice here is that the speed of network data movement is on the same order of magnitude as that of data movement within a computer (that is, when you take into account the fact that parallel transfers use eight data lines simultaneously).

The fact that internal data transfers occur even a little faster than data transfers across the network, however, necessitates the buffering, or temporary storage, of data on its way into the network. It is the job of the network adapter card to compensate for data-rate and throughput mismatches.

As you'll note in table 1, the Ethernet protocol allows a considerably faster rate of data flow than other systems. This is a topic

to which we'll return in a subsequent article.

**Network Data Movement (Data Structure).** Since the network shown in figure 1 must distribute processing and data-storage tasks among a number of users who may require near-simultaneous access to the network, data flow must be structured in a controlled manner. Control implies an orderly means of allowing each device access; it also implies a degree of service that allows data to arrive at its destination virtually error-free and in the same sequence it was transmitted.

A prerequisite to logical network control is the placement of data streams into formatted packets, which are then transmitted in accordance with network protocol.

The demands on a local area network system follow the irregular patterns of individual-user processing requirements. The irregularity, or randomness, of data transmission associated with these demands constitutes a form of data transfer called bursty communications. Network speeds are designed so that system demands, such as requests for file access, are fulfilled with no apparent delay attributable to the network itself. This type of system design, incorporating random bursts of data packets traveling at high speeds, is in stark contrast to what usually happens on modem network communication systems. Communications over a modem network are limited by the low-speed capability of that network; thus modem network sessions tend to be continuous in nature and typically last for at least several minutes, tying up a communication channel for the duration of the connection.

**LANs and Distributed Processing.** Once a local area network is physically assembled and the communications rules are established, some interesting challenges present themselves. These concern the concepts and rules by which the shared resources will operate.

One obvious problem concerns access to the hard disk drive: Which user has priority and how are multiple requests to access data from the same open file or files arbitrated? The answers lie more in how the accompanying software (the operating system or applications program) is designed than in the mechanics of data movement from point to point on the network.

One popular way of handling the matter is to partition the hard disk drive and assign a segment to each specific user. Each segment can contain several files, which will then be accessed just as a user accesses floppy disk files. We'll refer to such segments as volumes and consider them logically equivalent to floppy disks.

Another design challenge in local area networks is the handling of requests for floppy disk or printer access from the net-

Transfer Type	Operation	Typical Maximum speed (megabits/sec)
Serial	Network data flow	1.0/10.0*
Parallel	RAM read/write	9.5
Parallel	DMA transfer	9.5
Parallel	Processor-initiated I/O	7.6
Parallel	Hard disk I/O	6.5-8.0
Parallel	Floppy disk I/O	0.25
Serial	Multiuser terminal (RS-232)	0.0192
Serial	Modem at 1200 baud (RS-232)	0.0012

\*Ethernet

Table 1. Data transfer rate comparison

work while the pc workstation to which these devices are attached is in use by its operator. This situation is best handled by interfacing the network to multitasking or multiuser operating systems on the host pc; examples of these operating systems are Concurrent CP/M-86, MP/M-86, or the UCSD p-System. Existing solutions range from not allowing local use of a pc when it provides a shared device to not using a pc for attaching such shared resources. Prospective users should investigate carefully the operating systems that a particular network will support, as well as any restrictions in the use of a network pc as a shared resource.

Obviously there are a good many considerations that go into the choice of a local-

area-network configuration. Some of the key decisions concern the operating system or systems to be used, the design of applications programs to exploit the power of local networking, the amount of mass storage to include, and the need for modems and modem network resources. Another—more fundamental—decision must be made by the cost-conscious business user: whether to use an LAN at all or to go with a multiterminal, multiuser, single-CPU system.

The relevant variables to consider in selecting a local area network are summarized in figure 5.

*Next month's installment will take up the subjects of capacity, types of physical connection, and access rules.—Ed.* ▲

## FACTORS IN LOCAL AREA NETWORK SELECTION

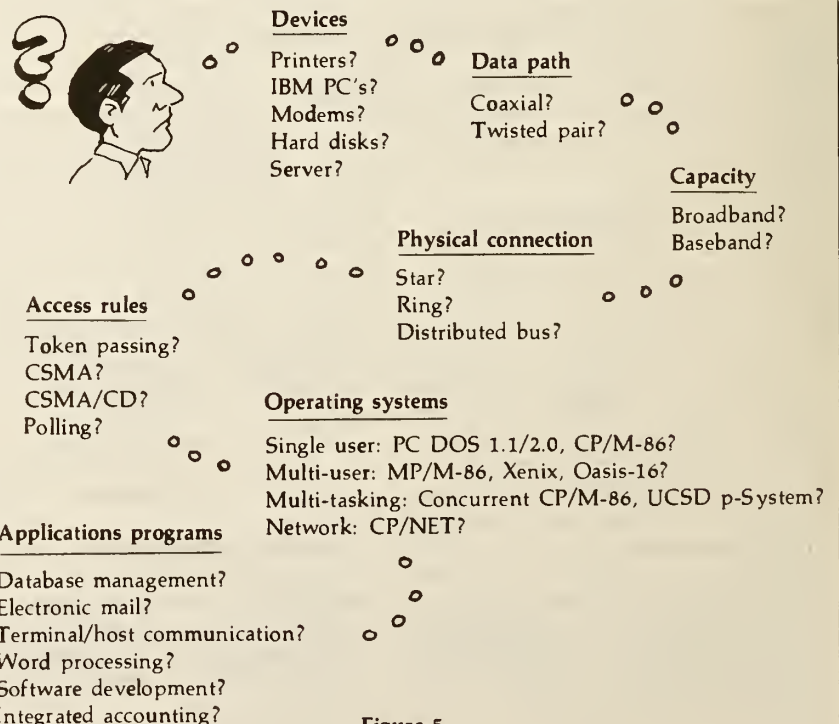


Figure 5.



## 8. ON-LINE INFORMATION

## IN FOCUS

# INFORMATION UTILITIES

**By John Markoff and Tom Shea, IW Staff**

Six months have gone by since you bought your personal computer. Sure, it's an electronic spreadsheet and accounting package for your business, and you have your word processor and data base, and maybe the kids can play games with it in the evening. Now, what else will it do?

For many, the next step is to turn the personal computer into an information and communications tool.

Traditionally, utilities have provided necessary services such as electricity, gas and water to consumers.

By the middle of the last decade, it became apparent that a new type of utility was on the horizon: the information utility.

Information utilities perform the service of providing electronic information that can be organized and tailored to users' needs.

In the future, a new generation of information utilities will use protocols that are different from or extensions of the standard ASCII character set to permit the transmission of graphics.

These systems may be accessible to personal computers that run special software to interpret the new protocols. They will, however, be targeted principally at users who have a computer hidden in a telephone or television.

Currently, most commercially based information utilities are accessible by standard ASCII terminals and microcomputers.

The principal difference between electronically delivered information and other sources of information is its greater selectability. Instead of having to search through vast libraries, users of an information utility can direct a computer to perform the task.

This much—selectability—is clear about information utilities, but perhaps little else is. The information-utility business today is a re-

flection of the topsy-turvy growth of both the computer and communications industries.

Personal-computer users can subscribe to information utilities that are run by companies as diverse as publishing houses, newspapers, banks, an aerospace contractor, a tax-accounting firm and, soon, by TV networks and the phone company.

The subject matter in the data bases is astonishingly diverse. Scientific data for petroleum engineers, UPI world news, the race records of 900,000 thoroughbred horses foaled since 1920 and information of use to sausage makers are all available.

The new industry is now also known by a potpourri of different names: information utility, videotex, teletext and viewdata, for example.

Not only are the sources of electronic information dissimilar, but so are the means of transmission. Your information utility can receive by telephone line, cable-TV network, radio and TV transmission and, now, satellite broadcast.

Little wonder that this new industry is surrounded by confusion! Yet despite the disarray and in the midst of a recession, information utilities have continued to blossom.

The Source, now owned by the Reader's Digest corporation, adds 2000 new subscribers a month; Dow Jones News and Retrieval Service, long a mainstay of the financial community, is widely advertised as being profitable and is considered the financial success story of the information-utility industry.

More recently, two traditional suppliers of on-line data bases to large corporations and institutions, Lockheed Dialog and BRS, have decided that there are already enough personal computers

to warrant special information-utility services.

Mike Raul of The Source, in McLean, Virginia, notes that people who have purchased a personal computer traditionally wait nine months to a year before deciding to subscribe to an information-utility service. He says that The Source is now seeing the fallout from the current personal-computer boom.

At the same time as large corporations are beginning to explore and market electronic-information services, grass-roots systems are also springing up.

Called "BBSs," or electronic bulletin boards, these systems are usually software programs that run on home computers. Other users can connect their computers to the bulletin boards over phone lines and leave messages or even upload and download professional-quality software.

The following is a brief introduction to the world of information utilities, ranging from getting started to what electronic information is available and how much it costs.

### Getting started

Starting out can be as simple as buying a used dumb terminal, hooking it up to an acoustical modem and dialing up an information utility through a telecommunications network.

It can be as complex as linking a personal computer to the transceiver of a two-foot earth station, which is designed to receive streams of digital data from space.

For personal-computer users the essentials are a 300- or 1200-baud modem and a telecommunications software program.

Modems range from simple acoustical couplers to intelligent modems that couple to personal computers through RS-232 interfaces or couple directly to the computer's bus.

A new generation of modems made by companies such as Hayes, Novation, Ventel and several others are "programmable"—you can write your own software program to control them. Alternatively, they can be controlled by special custom-built communications software that allows you to store access numbers and codes for a variety of remote computers, automatically log on to systems at the press of a single key and, in several cases, allows you to download files of information automatically and save them to disk.

The Hayes Smartmodem and Smartmodem 1200, for example, can be programmed to dial a number, to redial the last number, to answer automatically after a set number of rings and to switch between Touch-Tone and Pulse Dialing modes. The Smartmo-

dem 1200 version can switch between 300 and 1200 baud under program control.

Telecommunications software ranges from simple terminal emulators to advanced programs that support file transfer, with handshaking protocols that check for errors in transmission.

The trend in communications software is toward adding intelligence and offering "transparency" to users. In fact, soon programs will emerge that can handle all of the complex communications chores and give users a visual electronic mailbox to check.

Communications software will simplify the now arduous task of logging on to information utilities and laboriously searching through long strings of menus for information.

In the future, log-on protocols and search strings will be programmed into communications software. As a result, users will be able to get information at the push of a single button.

Already, Tymshare's Scanset, a compact, desktop terminal that has a built-in modem, allows host computers to download and store a specific log-on string that can then be used to access specific information in a data base.

Hayes Microcomputer Products recently announced the Smartcom II communications program, which will

support unattended file transfer and allow users to define and save separate profiles and log-on strings for different remote computers.

Some of the best communications software is free. In the CP/M world, there is Ward Christiansen's X-Modem program, which supports file transfers with error checking. X-Modem is in the public domain and in the program libraries of CP/M user groups.

For the IBM PC, PC World editor Andrew Fluegelman has written PC-Talk (now available in version 3.0). PC-Talk is part of Fluegelman's freeware scheme, which suggests that you send a payment of \$25 to the author if you find the program useful. It now supports Christiansen's error-checking file-transfer protocol and has a directory for auto-dialing 60 phone numbers.

### Data bases

Keeping track of all the on-line data bases that have proliferated over the past decade requires a data base itself. Knowledge Index, the recently announced subset of Lockheed Dialog, is designed for personal-computer users. It contains data bases that focus on subjects as diverse as agriculture, engineering, corporate news and computers and electronics.

Typically, on-line data bases allow users to perform on-line searches and



## In Focus

to retrieve citations of relevant articles and documents. Scientific data-base providers such as Dialog will also make the full texts of cited articles available for an extra fee.

In the future, it is likely that full-text, on-line retrieval of articles will be more common. Already, data bases such as Mead's Nexis provide full-text keyword-searching ability for the *Encyclopedia Britannica* and for a range of journals and periodicals.

Mead is currently not available to personal-computer users. It is provided only on dedicated terminals leased by the data-base company.

Another experimental venture, the Adonis Project, sponsored by several publishers, involves electronic delivery of scientific journals.

### Electronic mail

With the proliferation of personal computers, electronic mail is becoming more viable. As does "snail mail," information utilities offer users a

unique address. To send someone a letter all you do is call the electronic-mail routine when on line, write the text and then instruct the computer to send the message to the correct address.

To check to see if there is mail in your mailbox on The Source, you simply type the command "MAILCK" from the command line.

Advanced electronic-mail systems allow users to scan messages, save them on a file, send mail to multiple addresses, deliver mail on a specific date, password-protect a message, search through mail files by keyword or date and request a return receipt.

### On-line Support

As information utilities mature, more uses will emerge. One area that is a natural and that is sure to grow quickly is on-line support for personal-computer users. Currently, The Source and Digital Research are in

the final stages of creating a service that will allow CP/M users to access a special data base that will give support information on CP/M.

### Bulletin Board Systems

The electronic bulletin board or bulletin-board system (BBS) phenomenon has become a true grass-roots explosion in recent years. Across the country, literally thousands of personal-computer users have set up their systems as homespun information utilities.

It is not unusual to hear of home systems that have 1200-baud modems and ten megabytes of hard-disk storage to support uploading and downloading of software.

Many BBSs focus on a specific topic, such as one type of personal computer or software. Others now support feature articles and on-line documentation, as well as public and private

messaging services.

Most bulletin boards don't charge fees and can be accessed for the cost of a single phone call. Some systems assign passwords to users.

Part of the BBS phenomenon is a thriving computer underground. Pirate BBSs are now spread throughout the country, and users exchange information about software piracy.

One of the first BBS "Dick Tracy" incidents happened in Silicon Valley several years ago. Local police, the FBI and private security agents who had a warrant kicked down a door in an apartment to get a BBS system on which users were discussing phone "phreaking." No arrests were ever made.

Probably the best way to keep track of which BBSs are currently active is to subscribe to the On-Line Computer Telephone Directory published by Jim Cambron. Subscriptions cost \$9.95 and can be obtained by writing to PO Box 10005, Kansas City, MO 64111. ■

# Videotex

*As users turn to data bases to meet their information needs, videotex will become a common office tool.*

**By Bernell Wright**

No one correct method for automating an organization exists nor will it probably ever exist. While networking may be the answer for one office, a platoon of personal computers may be the answer for another. And as the technology continues to develop, users may find themselves working with videotex to facilitate office automation in certain organizations.

Heavily influenced by increasingly sophisticated automation, the U.S. and major parts of Europe are shifting from industrial to information economies. Evidence of this trend has existed in the office environment for some time. Only recently, however, has this shift invaded the executive/professional work place, and as corporate managers plan and implement office automation systems in the '80s, the invasion may become a full frontal assault. Knowledge workers will be called upon to interact with data bases and mainframe-stored information, and they may not possess the computer literacy to do so.

Software is being developed to take into account the user's level of computer literacy, and methods are being found to make it easy and pleasant for users to deal with computer-based productivity. Software brings the promise of an appropriate interface to facilitate the man-machine dialogue — referred to here as "user-driven" solution.

Videotex can allow the economy, control and flexibility needed for successful implementation of white-collar worker automation. However, for videotex to exploit its service attributes in the business arena, new approaches to the system configuration will be needed. The traditional emphasis on mass market or residential users has helped to obscure the application-oriented use of videotex as a component in OA executive workstation implementation.

Before exploring the role of videotex in OA, however, we should review briefly the development of the concept of office automation. OA is frequently divided into four evolutionary phases:

- Data processing, starting in the late 1950s.
- Word processing, starting in the mid-1960s.
- Integration of WP with other functions. For example, WP merges with communications to produce electronic mail.
- A period of customization. Office communications system control will be customized for managers and professionals, some recognition of the multifunction workstation will be achieved and extreme user-friendliness will be emphasized.

**I**n the U.S. particularly, we are in the third stage of office automation. Today's literature is awash with product announcements that extol the integration of discrete functions to produce the convergence of voice, video, image and data capabilities. This trend should generate optimism among users, but these vendor-driven solutions have rarely been developed with the user in mind.

In truth, many of these vendor-driven solutions have been aimed at creating a franchise for that vendor's equipment. This was clearly the strategy of Xerox Corp. with Ethernet. Although local-area networks have been and will continue to be major contributors to the advance of OA implementation, they do not fulfill knowledge workers' needs for user-friendly tools. Videotex can add new elements of user-friendly systems design, namely, communicators' control and cost-containment. This front-end-processor videotex solution supports:

- Screen bypasses through multiple entry point in logical fashion.
- Command-level functions that provide an alternative to pre-specified screen fields and formats.
- Alternative screen formats for knowledge workers at different levels of computer literacy.

When and if these events happen, videotex technology will appear transparent to users, a key issue to knowledge workers seeking better solutions to existing problems or applications. The traditional stand-alone videotex terminal

will be replaced by multifunction terminals that support the merging of internal and external sources of data, voice, image and video routinely via local-area nets. Data base organization schemes will serve the user's needs, and the user-driven aspects of videotex could emerge as a major contribution to fourth-generation office automation.

**What is videotex?** Historically, videotex, first known as viewdata, has undergone many definitions. One of these comes from Europe, in the form of a standard for videotex. Set by the Conference of European PTTs (Cept) this standard incorporates the national efforts of British Telecom's Prestel and the French authorities' Antiope. The Cept standard can best be seen as a political accommodation to two competing system technologies from the continent as they approach the world market.

A North American standard also exists for videotex. This standard, also known as the Canadian CRC Technical Note No. 709E, incorporates the AT&T Presentation Level Protocol with Canadian Tello technology. The standard provides for encoding text and graphics information for optimal communications. It is a display standard, which, from a systems architecture focus, defines the presentation layer within the International Standards Organization's multilayer Open Systems Interconnections Reference Model.

The issues involved in setting the above two standards are very important, but they fail to cover

product and market development issues. A broader definition is more useful here. Videotex is:

- A generic term used throughout Europe and North America for two-way information retrieval systems using telecommunications lines, mainframe and computer-terminal configurations.
- An umbrella term for low-cost, easy-to-use interactive information retrieval systems.
- A series of attributes with technological alternatives that displace current status quo solutions with lower cost or value-added solutions (productivity enhancements).

**V**ideotex, then, is really a concept that includes attributes and technology directed at placing more of the burden of man/machine dialogues on the machine and less on the man. This is the real meaning of "user-friendliness" in the computer context.

In this larger sense, videotex should be seen in the same light as the new computer terminals symbolized by Xerox's Star and Apple Computer Inc.'s Lisa. While the hardware of both is significant, the real story is in the way these products approach software. Instead of making the target knowledge worker learn computer commands, they allow him to manipulate pictures that let work be performed in ways the user finds familiar. Carrying this concept to its natural conclusion, videotex and personal computers with template command processing can be considered as a transitional tech-



videotex technology has also undergone several changes in topology. In fact, in the QA context, videotex is an expansion of network access and data base organization issues, all culminating in front-end-processor technique. An evolution of videotex network architectures follows:

- Prestel: Targeted at the residential market; low-cost, simple-to-use, closed data source.

- Bildschirmtext: Targeted at the residential market; low-cost, simple-to-use, opening of data source gateway concept, closed user groups.

- French Videopad/AT&T proposed standard: Boolean logic, closed user group extended, use of a packet-switched network or full connectivity via public switched telephone network (PSTN), to unlimited data source.

Prestel began as a closed system that linked internal data bases for information only. Further, because Prestel pages were preconstructed prior to transmission, no concept of merging inputs was possible. Bildschirmtext, with its gateways or windows to external or third-party data bases, opens up the network and supports X.25 access. Business users without networks can become closed user groups and treat the Bildschirmtext backbone as a service bureau of value-added networks. Analysts will see the technology. The ultimate in user-friendliness for knowledge workers is achieved through voice recognition/synthesis technology. An example of this is digital speech interpolation (DSI) which promises unlimited personalized information processing and transport at home, office and in between.

However, no products have yet reached this level, and the technology is still some years off.

**How is videotex deployed?** Visibilities to the new IBM Information Network and American Bell's Advanced Information Services Net 1000 offerings.

The now-developing French Videopad program and AT&T presentation level protocol activity brings traditional business user search technique — specifically, boolean search or logical connectors using "and," "or" represented by a comma and "not." In addition, they bring a

## ***"Videotex could emerge in the form of new options on time-sharing bureaus, as well as on information retrieval services."***

PSTN backbone network for full connectivity or packet-switched network for interoffice and intraoffice communications and transaction processing.

**Videotex in the QA initiative.** Videotex can be a part of the QA evolution because of the concept of front-end processing. The videotex front-end processor gives vendors and users two major capabilities: communications control and screen management.

We expect to see front-end flexibility as a part of user implementation solutions. This means users will have an in-house base of intelligent workstations. Intelligent terminals can perform videotex processing of information off-line, which will allow users to control the actual telecommunications session and its cost. The ability to provide cost-containment and information management through gateway and screen management capabilities of videotex are key inputs to QA users.

Communications control is becoming increasingly important in an environment where multiple delivery schemes — voice, video, image and data — are becoming available. Cost-justification for various communications media is now a central task in evaluating implementation. With the increasing flexibility of communications comes an increased need for protocol conversion. As more devices are interconnected, a common protocol is needed; since there is no common protocol, protocol conversion becomes important.

Not surprisingly, protocol conversion is one of the value-added services that AT&T's new ABI subsidiary will supply. It is also one of the value-added functions that a videotex front-end processor can supply, where the primary conversion is from Ascii or IBM protocols into videotex protocols.

The videotex protocol itself is one of the emerging major standardized languages for text and graphics. As the videotex standard is resolved in the next two years and its ability to serve as a common reference point for data communications emerges, the ability of time-sharing and telecommunications entities to use videotex for protocol conversion will be greatly enhanced for users.

The second capability — screen management — is derived from the issue of protocol conversion. Screen management is the capability to merge data interactively from an external or an internal source with user-friendly videotex format. The videotex page serves as a mask for the non-videotex-format information source. In this light, videotex truly becomes a communications vehicle, rather than a new stand-alone rigid information format. The front-end processor's screen management capability supplies the necessary flexibility to allow videotex systems to be employed in a cost-effective fashion in office information environments.

In this context, videotex is no longer videotex perceived as a distinct and somewhat limited information format. With the screen management capability, it becomes a common friendly context for all information needs. The result is a complete management information system for knowledge workers. This is, of course, the goal of many QA and information vendors.

When examining the movements in videotex toward a cost-effective solution for communications and screen management, we can see videotex joining office automation by becoming a solution that can be implemented by the end user. Vendors in Europe were early in sensing this. Argon Group Ltd. and Rediffu-

sion Computers, Inc. in the U.K. have become QA videotex vendors by supplying turnkey systems for end-user implementation. Both are now in the U.S., as are scores of turnkey software systems houses.

Videotex could then emerge as new options on time-sharing bureaus, as well as on information retrieval services. The basic question is why — given the fact that graphics are nice, but not essential to most DP/information retrieval applications in use today. One answer is that the knowledge worker/end user has no allegiance to the DP department. He isn't seeking a formal data base management system, but an integrated nonproprietary management information system. He isn't looking for increased data flow, but rather for increased decision capability. Graphics help when they are recast as synthesizers of detail. For example, a pie chart depicts all distribution outlets for a product, a time series depicts years of sales performance.

Another answer is that videotex technology is volume-dependent — knowledge workers will open up a new class of low-cost terminals and terminal enhancements that will make computer power from in-house or remote installations more available.

One more subtle answer — borne out by the apparent success of Rediffusion's Viewdata Plus program — is that videotex serves as a nonproprietary approach to data management. Videotex is a generic data management system readily understood by users who may not know the ins and outs of a proprietary data base management software offering. With the quickly developing offerings by IBM Information Network and ABI's Net 1000 in addition to other time-sharing computer processing services, videotex may be a sales strategy component. Videotex front-end solutions are likely to leverage some vendor offerings because the videotex capabilities will appeal to the decision-making team that includes high-level end users as well as traditional MIS planners. **QA**

Wright is manager of the videotex programs at Link, a research company based in New York.

## 9. SUPPORT



## INFORMATION RESOURCE CENTERS - ORGANIZING TO SERVE END USERS

Thomas N. Pyke, Jr.

National Bureau of Standards  
Washington, D. C. 20234Abstract

This paper summarizes the motivation for and issues associated with organizing to support end user direct access to computing resources. A combination of information center functions to provide access to large mainframes and support to end users in their access to microcomputers is included. Various issues are identified and discussed that will help organizations develop supporting organizational structures for end user computing.

Introduction

Direct access by end users to computing resources is becoming commonplace. Organizations are developing a variety of ways to assist these end users. Some organizations have established information centers to hold the hands of end users of mainframe computers. Another form of support is the microcomputer center, to help end users in selecting and using their desktop computers. There are advantages to integrating organizational support for all forms of end user computing, both to assure that individual users and their applications are matched with the most effective computing resources, and to assure that overall organizational objectives and constraints are met.

In describing this integrated approach, this paper uses the term "information resource center." An information resource center provides information, consultation, technical assistance, and training to end users. An "end user" is anyone at any level in an organization who has a requirement for computer-based support, who is not a professional programmer, and who does not expect to become one.

Motivation for End User ComputingObjectives

An information resource center can provide better delivery of all forms of support to end users of computer-based systems. This can result in better and more timely decisions being made at all levels within an organization. In many cases, it can decrease computing costs. Some organizations may see a significant benefit in encouraging user-driven computing in itself, and

this may become a primary objective in the establishment and operation of an information resource center. In addition, organizations have begun to realize the need to establish organizational constraints on end users, such as to assure integrity of data, auditability of the results of computing, and data and program security.

Driving Forces

The environment in which these objectives have been identified and in which end users are coming on their own is one in which managers' demands for data and data analysis are growing. This is happening concurrently with a general growing public awareness of the availability of computers, especially microcomputers. Schools and homes are fast becoming hotbeds of hands-on activity involving microcomputers. Newspapers, magazines, business periodicals, and many other publications have feature articles on the use of computers. Advertisements for personal computing appear frequently in all forms of the mass media as well as in business and trade publications.

Traditional data processing support staff are spread thin, especially with the continuing burden of maintaining existing software coupled with efforts to meet new demands. Substantial application backlogs exist. These include documented applications waiting for attention from data processing support staff as well as an "invisible" backlog of applications which have not yet come to the attention of data processing support staff because end users believe such an effort would be futile given these applications' priority and the data processing staff availability. End user concern about not being able to rely on the data processing staff is apparently especially strong for the creation of small programs and making quick changes to existing programs.

A substantial amount of attention has been given over the last few years to "user friendly" or "user oriented" application packages, for both mainframes and microcomputers. Packages such as

VisiCalc\* have been heralded as major breakthroughs in providing computing support directly to end users. In addition, very high-level languages, including those related to database management systems, can frequently be used by end users with only minimal assistance.

Finally, computer hardware technology, including logic, main memory, and peripherals, has evolved rapidly over the last several years, to bring substantial computing capability at acceptable cost to the individual for business and home.

In the next two parts of this paper, the two currently predominant forms of end user computing support that respond to these driving forces, the IBM information center concept and microcomputer support centers, are discussed. This is followed by a presentation and discussion of the issues involved in providing integrated support for end user computing.

#### IBM Information Center Concept

The concept of the "information center" was developed by IBM Canada in the mid-1970's, and has been accepted and implemented in several different forms.<sup>2,3</sup> It is reported that over 40% of medium and large scale IBM computer installations already have an information center supporting end users in operation. IBM-style information centers assist end users in directly accessing a set of software packages that operate on inhouse mainframe computers. The software packages are carefully selected so as to be of major benefit to end users in setting up new applications with minimal support from information center professional staff and without the use of professional programmers. Information centers are usually "captive" of an organization's inhouse data processing operation, and serve to promote centralized, mainframe-oriented support, typically under the control of mid-level data processing managers.

Organizations have reported end user satisfaction with the establishment and operation of information centers. At the same time, the creation of information centers has resulted in a need for additional mainframe computer capacity. Many organizations supporting information centers have had to upgrade their CPU and other computing resources. In some cases, entire new mainframes have been installed to satisfy direct end user demand stimulated by having an information center. The long term effect on end users of the availability of information centers is open to speculation. It has been suggested that information centers may only whet the appetites of end users for more computing capacity and related services.<sup>4</sup>

---

\*Registered trademark. The naming of products and organizations in this paper is solely for the purpose of identification in order to make certain points in the paper, and no endorsement by NBS or any other meaning is intended.

#### Microcomputer Support Centers

A number of organizations have reported success in helping end users through the establishment of microcomputer support centers. For example, the American Can Company operates a major microcomputer center that provides hot lines for end users, opportunities for sharing experiences in the use of specific programs, general knowledge about micros, and "tips" on micro use. Training is provided to end users, and assistance in custom programming is provided when appropriate.<sup>5</sup>

Travelers Insurance Company has established a Personal Computing Center, which is operated as an internal store similar to commercial computer stores.<sup>6</sup> It is reported to be operating as a part of an information center within Travelers to provide centralized coordination and support to end users.

A number of Federal agencies have established microcomputer support centers along with initial operating policies for the acquisition and use of microcomputers.<sup>7</sup> One example of such an activity is the Department of Agriculture's Information Technology Center, which provides demonstrations of microcomputer equipment and assistance in acquiring and setting up new systems.

#### Integrated Support for End User Computing

End user access to mainframes and use of microcomputers are part of a larger picture of supporting end users in an integrated manner. An information resource center can provide effective integrated support to end users.

#### Deciding Among Alternative Forms of End User Computing

An objective, unbiased source of assistance to end users can help them to consider using desktop computers, accessing inhouse mainframes, or using remote computer services outside the organization. Each application or class of applications can receive special attention, with all relevant information made available to the end user to decide which alternative form of computing is best. The end user can be helped to determine required functionality and the level of performance necessary to satisfy known requirements and to evaluate alternatives against these requirements.

End users can be provided general information and evaluations of specific hardware and software products, as new alternatives continually become available. Emphasis can be given to planning for a transition to newer technological solutions as they become viable, while supporting existing and current applications effectively with currently available technological solutions.



## Assistance in Selecting Software

The information resource center can maintain a catalog of information about available applications software for alternative system configurations. Because of the impossibility of a relatively small staff having detailed information about many applications packages, the information resource center can provide a "window" to sources of first hand information about each package. End users can be helped to select and use application and program generators as appropriate, in addition to very high-level languages. It has been reported that over 30% of the information centers in operation support the use of FOCUS, over 15% support RAMIS, and over 60% support SAS.

The staff of the information resource center can provide minimal application analysis. Training can be provided or arrangements can be made for training of end users. When necessary, end users can be referred to inhouse or other available data processing staff for extensive programming or more detailed application analysis.

## Common Focus for Data Administration

Although centralized data administration support is already provided within some organizations, an information resource center represents an opportunity to address some of the data-related problems created through end user computing. End users can be informed of what data exists and how they can access it. They may be assured of the availability of data where and when needed through the use of the alternative forms of end user computing.

Appropriate organizational controls can be established to assure data integrity and accuracy. This support can assure that decisions made throughout an organization are based on consistent and reliable data.

## Satisfying Organizational Constraints

Implied in the data administration function is an organizational need to control data. This includes assuring the confidentiality of data within the organization and controlling the extent that it may be externally accessible. Auditing the use of data and programs may also be required.

The input and use of data by end users employing microcomputers may lead to the use of practices that are generally unacceptable in more traditional data processing operations.<sup>6</sup> Logic and range boundary checking of data as it is entered beyond the context of the immediate data entry may be desirable and may require continuing access to a larger data base as data is entered.

## Organizational Placement

The use of the terms "objective" and "unbiased" above implies that the information resource center not be an advocacy organization

for any particular form of end user computing. It also means that the center should be separate from any inhouse, operational data processing installation so as not to be captive of the orientation of the management of such an installation. It is important, however, that an information resource center operate under the auspices of the organization's senior official responsible for information resources management. This individual should encourage an open-minded attitude in supporting the appropriate use of the alternative forms of end user computing. This contrasts with the viewpoint of the manager of an ADP installation or the manager of a microcomputer support center, which itself may be an advocacy group for microcomputers.

Although the information resource center may be thought of as a "logical" entity which may be distributed organizationally, a central group in each organization can avoid redundancy in providing all forms of end user support. It can also provide a common focus for the interconnection of desktop computers, the direct use of inhouse mainframes, and access to remote computing and data services.

## "Helping" Vs. "Controlling"

End users will have a perception of an information resource center in terms of whether it is "supportive", as a source of information and assistance, or "controlling", in the sense of being an obstacle or hindrance rather than a help. This perception is likely drawn as much from the methods used to exert whatever controls are applied as to the existence of the controls themselves. For example, the use of incentive-based techniques that encourage end users to select microcomputer hardware and software that has been determined to be desirable from an overall organizational viewpoint can provide both assistance to end users and control at the same time. Assistance in accessing data, such as in downloading it readily into microcomputers from the mainframe, can be both a service to end users as well as a means for controlling data consistency within the organization.

## Concluding Observations

All of the forms of end user computing identified in this paper are proliferating rapidly. The International Data Corporation projects that in 1986 U.S. desktop computer shipments totaling \$14.2 billion will exceed U.S. mainframe shipments of \$13.7 billion. This astonishing projection exemplifies both the nature and rapidity of change in both public and private organizations.

End users are coming more into their own, with senior program managers, who are or who represent senior end users, gaining more "power" within organizations relative to information systems managers. One interesting question is

whether the eventual domination of computing decisions by end users is a fait accompli or whether this trend is being accelerated by the establishment of information centers, micro-computer support centers, and other forms of commercial and inhouse support of various forms of end user computing. Although one may speculate as to the "chicken and egg" nature of end user demands versus support for end user demands, there is now no doubt that end user computing is a powerful force. It must be dealt with effectively and quickly by all levels of management within each organization. The ideas and issues discussed in this paper directed toward considering end user computing in an integrated fashion are proposed as a contribution toward a better managerial and technical basis for handling the inevitable demands of, and support required by, end users.

#### References

1. "DPers' No. 1 Headache? Applications Backlog," Computerworld, April 11, 1983.
2. L.W. Hammond, "Management Considerations for an Information Center," IBM Systems Journal, Vol. 21, Number 2, 1982.
3. James Martin, Application Development Without Programmers, Chapter 19, "Information Center Management," Prentice-Hall, 1982.
4. Richard G. Canning, EDP Analyzer, Vol. 20, Number 6, June 1982.
5. J. Fioravante, "American Can Company's Micro Center Turns into Smash Hit," MIS Week, February 17, 1982, page 27.
6. "Travelers Insurance Company Makes it a Policy: Personal Computers for Everybody," Computerworld, July 19, 1982.
7. Dennis Gilbert, E. Parker, and L. Rosenthal, "Microcomputers, a Review of Federal Agency Experiences," National Bureau of Standards, Special Publication Number 500-102, June 1983.
8. W. R. Synnott, "Microcomputers Threaten Central Data Control," Information Systems News, November 29, 1982, page 15.



# Computer-Based Training

By Kate Barnes

**O**ffice automation and end-user computing are often characterized as being easy, quick and efficient. All those things are true — once you get the hang of them. However, achieving that first familiarization can be a threatening experience for many users. In addition, when a user does become familiar with one machine or software package, switching to a different machine or package can present a new threat.

Most users of automated tools have one thing in common. They want to reap the benefits of automation without wading through pages of accompanying documentation. The president of a major software company recently acknowledged that the majority of users want simply to insert a disk in their machines

and get started — but today's software just isn't friendly enough for that approach.

**A**s learning tools, vendor manuals and documentation can be difficult to master, and technology is still too complex to plug in and use.

With users in a hurry to learn and technology hard to understand, a gap exists. In an attempt to keep this gap from widening, some vendors have responded with classroom instruction and self-paced learning manuals. A brisk business has also emerged in third-party publishing of training guides.

However, problems still exist. Classroom training is expensive on a wide-

scale basis. Training guides, whether produced by the vendor or a third party, can still lose the user's interest and/or understanding. An alternative method is the use of computer-based training. In computer-based training, a specially designed program teaches the student how to use a given piece of automated technology. The user is prompted and guided by the computer in learning about the technology.

Most users seem to appreciate learning via the computer, and some outright enjoy it. For example, Individual Software, Inc.'s "The Instructor" has successfully taught several of my neighbors how to use the IBM Personal Computer keyboard. Perhaps user reactions to computer-based training are best

summed up by one user's response to a hands-on demonstration at a recent trade show. After working half-way through a training program on Wordstar, she turned to her companion and said, "Exactly what I want!"

Computer-based training offers many advantages over classroom or manual-directed alternatives:

- **Environment:** The user can get right to work on the machine he will be using.

- **Simulation:** Computer-based training programs typically simulate the characteristics of the machine or the software package being taught. Users are able to learn while doing. This all occurs in a controlled setting that prevents the student from getting lost in the system.

- **Customization:** No two students have the same needs. With computer-based training, no two students will have exactly the same learning experience. The computer is able to respond with helps, branching and reviews as required.

- **Speed:** The most-used characteristics of the software can be taught in a matter of minutes or hours.

- **Convenience:** Training can conform to the student's time schedule.

- **Cost:** Computer-based training is easy on the budget.

- **Success:** There is less chance the student will be seriously frustrated because computer-based training controls the learning experience. Many educators also believe computer-based training

produces a higher rate of retention than other presentation formats.

**P**resently, computer-based training is just gaining a foothold in the business arena. According to company representatives, if you purchase an office system from Wang Laboratories, Inc. or a Displaywriter from IBM, your training alternatives will be limited to classroom training or self-instructional manuals. IBM does have computer-based training available for some of its other office products. Both companies use the computer to assist in internal staff training.

QA alternatives involving personal computers offer more training choices. Several companies are de-

Computerworld QA

## FOCUS

veloping and marketing computer-based training for popular office packages such as VisiCorp's Visicalc, Micropro's Wordstar, Xyquest, Inc.'s Easywriter II, Multiplan, Ashton Tate's Dbase II and others.

**T**hese training packages typically are offered for a purchase price in the neighborhood of \$50 to \$100 per course. Considering that most personal computers in the business environment represent a payout of \$4,000 to \$10,000, including software, a quick, sure way of learning to use the personal computer is certainly worth the investment.

One of the first questions users ask about software is whether to make or buy it. If the training you seek is available in CBT form, I'd emphatically recommend buying it; in terms of both hard dollars and labor, it will be less expensive. Before buying, you should ask yourself the following questions:

- Is it easy to use? You don't want to have to be trained to use the training.
- Does it teach what it says it will teach?
- Is it compatible with your hardware?

- Is it engaging? Will it hold the learner's attention by means of graphics, varied activities and student involvement? Stay away from passive training that requires the user only to press the RETURN key. Questions, simulation and effective humor all keep involvement high.

- Does it use effective teaching methods? True/false and multiple-choice questions are good testing devices, but may not be the best ways to teach students how to use a software package. Simulation controlled by the computer can often give the student a more practical experience.

- Does it offer complete coverage? Don't be fooled into believing that spending less time in training means learning the subject thoroughly.

- What is the reputation of the company among its customers?

- Does the vendor provide telephone and on-site support services?

What do you do if computer-based training is not available for your particular need? If that need is large in scope, you may want to investigate the "make CBT" option. Before you dive in, take a close look at the cost in terms of time and money.

First, decide if your problem is suited to this kind of training. If it

is, determine whether an authoring system is available. Using an authoring system means you design the training and input the data. The system then generates much of the computer code. Authoring systems can be costly. In addition, some authoring systems are prohibitive because the author essentially has to learn a complicated system language. Of course, CBT programs can be coded line by line, but I don't recommend

---

***"If your need is large in scope, you may want to investigate the 'make CBT' option. Before you dive in, take a close look at the cost."***

---

this approach unless the time, money and programming talent are readily available.

Suppose your organization has a fairly complex customized correspondence/data base office system. Because of turnover and staff expansion, 20 people must

be trained to use the system each month. That can add up to a lot of time in training or a lot of system misuse. If an IBM mainframe computer is part of the system, IBM's IIS authoring system might be an alternative. If you are using a configuration of Apple Computer, Inc. computers, Apple Pilot may be useful. Or, if you have a variety of personal computers, an authoring system like Coursemaster (Digital Research, Inc.'s CP/M-based) may meet your needs.

After identifying the means of creating the CBT, you should then move on to costing out the project, including the labor and time involved, the hardware and software needed for course development and the cost of duplicating the CBT training to make it available for many users.

The importance of technology to organizations is growing; the popularity of computer-based training seems likely to grow along with it. **QA**

---

*Barnes, West Coast manager, telecommutes from Tucson, Ariz., to Deltak Microsystems, Inc. in Naperville, Ill. Deltak Microsystems offers computer-based training on a variety of QA and computer-related topics.*



**For the uninitiated to succeed in computing,  
they need training, the right equipment—  
and good coaching.**

# END-USER GAME PLAN

**by Hugh Ryan**

Systems departments can't keep up with user demands for their services. Recently, end-user computing environments have been touted as the way to cut through the dp services backlog. And, because of the microcomputer's rapidly increasing popularity, more and more end users find themselves in a computing environment. Many people are wondering if they should be moving in this direction; what will it mean for them in one year, or in five years? Of greater concern, these people need to know what factors will make their end-user computing environment productive and successful.

After working in numerous client organizations, I have observed that the following factors are necessary to create such an environment:

- relevant user training,
- coaches,
- evolutionary development of systems,
- appropriate data delivery systems, and
- effective use of fourth generation software tools.

Each of these factors should be part of short- and long-term end-user computing strategies.

Walk into any end-user computing environment and you will probably find that the users come from a variety of backgrounds, ranging from shop floor machinists to MBAs. They are likely to have equally varied levels of knowledge about computers and systems development. Training is needed to build a common foundation of knowledge among these users. They must be trained not only in the tools of the end-user environment but also in computer fundamentals and the rudiments of systems development.

Training must begin at the most basic level. For example, inexperienced users will most likely encounter difficulty translating their computing demands into suitable machine form, organizing the logic so the machine can follow the intention of the designer, and determining the time requirements of the job.

Training, like systems, must be designed and developed. The first step is establishing a curriculum that defines the courses

and their sequence, and includes an overview of each course's content. The curriculum must begin with such basics as turning the terminal on, signing on, and interpreting systems messages. Courses should build on each other, until topics like software products and system development are covered.

It is essential to realize that for end users, the computer is a tool, not a career. Interest in the machine lasts only as long as it assists them in their work. Therefore, users should never leave a course without learning some things that help them in their daily work.

In addition, because users have a limited amount of time for training, the curriculum should be organized into short modules of one half to two days per course unit.

Software vendors often provide material that can be used to train end users, but some customization is usually required. Examples related to the user's specific enterprise are helpful. Promotional and technical data from the vendor will need to be deleted or moved to a later curriculum sequence.

As users advance through product-oriented courses, they'll also need to know about systems development. Therefore, a methodology for systems development and training should be established. Methodologies are now being defined for the end-user computing environment which should facilitate teaching users how to develop a system.

## COACHES CAN SOLVE PROBLEMS

Even when the training and methodology are set, unanticipated problems will still arise. For example, I know of a user who was unable to sign on by himself, because in class the terminals had already been on. In another case, a top management person was delayed over a weekend in his task because of confusion about how indexes worked. To prevent these problems from happening, people variously called coaches, consultants, or advisors are needed. By any name, they are key to the success of end-user environments.

One cannot simply designate any individual as a coach and expect success. Good coaches must have several innate qualities.

DECEMBER 1983

## End users become nonusers when they perceive that their coaches know little more than they do.

The characteristic I have observed most frequently in successful coaches is a "can do" attitude. I know of a coach who, upon learning that a user needed some data that required numerous approvals prior to release to end users, slipped into a tape room, removed the tape under a coat, copied it, and then returned it. While I cannot recommend such an action, it is indicative of the coach's "can do" attitude. In this case, the user drew some significant and timely conclusions with the contraband data.

The successful coach likes to work on many different, short-term projects, and can estimate the effort required for proposed projects. Data processors who derive great satisfaction from long-term projects that require continued analysis of the same area will not be happy as end-user coaches. Good coaches can also make quick decisions on whether a project is suitable for the end-user environment or the systems department.

The coach should be knowledgeable about one or two of the tools employed by end users. End users quickly become nonusers when they perceive that their coaches know little more than they do. This is particularly important when introducing the user to an information center; she must believe the coach possesses a craftsman's knowledge of all the necessary details.

While coaches need an in-depth knowledge of one or two tools, they must also understand the capabilities and limits of fourth generation software tools. Indeed, fourth generation tools in the wrong environment can be counterproductive. The inexperienced user needs a coach to judge which tool is right.

Coaches must get along with end users. A coach should be assigned to an end user based on at least a superficial review of the personal characteristics of the two. Moreover, the assignment should be an ongoing arrangement rather than one based on whoever is available when the user calls. An end user will feel the arrangement is unproductive if she must continually explain the problem to new faces.

The coach must also learn the end user's business. The systems that end users write are closely related to their businesses. They are written in terminology the user knows and are performed as the user would expect. The coach and end user must communicate in the end user's language. I know of one coach who became so involved that he was eventually absorbed into his end user's department, where one of his ongoing tasks is further system development.

As the coach works with higher-level management, the ability to understand and solve business problems is crucial. In the top levels of management, coaches can become

valued advisors, serving almost as a machine interface to get management the information it needs.

End-user systems tend to evolve through many versions. Such development is difficult for most data processors to accept, because it means users won't know their requirements until they see the system. This seems contradictory but can, in fact, be resolved through iterative development of different system versions. The emphasis changes from "What do you want to do with the data?" to "What data do you want?" It is reasonable to expect an answer for the first question, but management cannot answer the second question without seeing the data.

Another feature of evolutionary development is the speed of delivery in any iteration of the system. The system user must see a cycle completed quickly enough to be assured the system is moving forward. While there are many definitions for "quick enough," a common guideline suggests no more than 100 person-days per iteration. This is an upper limit. Many iterations require only a few hours.

### COMMITTED USER REQUIRED

A third feature of evolutionary development is a committed, involved user—meaning the user must often write logic for execution. Users will certainly be involved in the heavy initial use of the system and will direct each iteration of the evolving design. This commitment is particularly key to evolutionary development since early versions of the system may be rather rough and may suffer from such problems as program aborts, data exceptions, and logic flows. In this phase, users must see progress toward a desirable system or their efforts will cease.

I know of a system that was developed on an evolutionary basis with extensive user involvement in design coding and testing. The user went through all the problems of the early states—incomplete screens, lost data, and execution time problems. At a later phase, several extensive inquiries were added to the system. After additional criteria were added to one inquiry, run-time increased from one to two minutes to four to six minutes. Yet the user took great pride in the run-time increase because it reflected the additional problems his staff had experienced when doing the inquiries manually. The user was truly committed to the system.

In a successful multi-end-user system environment, expect a proliferation of end-user data stores, along with the problems of synchronization and coordination with the original data source. A typical architecture defined for an end-user environment consists of iteratively developed software, normally

using a fourth generation language. The system uses an end-user data store usually developed for the specifics of the end-user system; that is, one end-user data store serves only one or a few end-user systems.

The end-user data store is maintained by a data delivery system (DDS). The DDS component takes data external to the data store and puts it in a suitable format. Depending upon the tool, there may be a vendor-supplied product that loads the data into the data store. Most systems have more than one DDS. The data source is external—it may be a transaction system database or data supplied by a vendor. Given the wide range of possible sources, a DDS will probably be designed and implemented for each data source.

The DDS is one of the most complex components of an end-user environment. DDSs must handle all the typical problems of a transaction system—such as data validation, reformatting, and extraction—in a typically high-volume situation. In addition, it should address the question of synchronizing the end-user data store and the data source. This alone can be very difficult when adjustments are made to the data source. A well-designed DDS is important to a reliable end-user data store and, in the long term, to the viability of the end-user environment.

The DDS is one of the most underestimated parts of an end-user environment. In the initial enthusiasm about the new environment, selection of suitable hardware and support receives great emphasis; the DDS components may be no more than an extract and load to the end-user data store. To get things going, this quick and dirty effort is reasonable and often advisable. The problems arise when this initial version becomes the model for subsequent DDS efforts. In two to three years, the lack of validation and controls will result in an unreliable end-user data store, and everyone will wonder how it happened.

The DDS is a crucial, but often unacknowledged, portion of the typical end-user environment. It should be used not only to extract and load data but also to validate, cross-check, and apply controls in a high-volume environment. In addition, it must be coordinated and changed as the external data source changes.

### ACHILLES' HEEL OF SYSTEM

These requirements imply that a viable data delivery system is similar to a classical transaction processing system and should be developed using the techniques and tools of that environment. This in turn implies that when an end user contemplates a new system, which requires a new data store, then a DDS's component will be developed by dp, using third generation tools. Developed at third generation speeds,



## The DDS is a crucial but often unacknowledged portion of the typical end-user environment.

this component is often the Achilles' heel of the end-user environment because of the long lead time for delivery and the embedding of ongoing third generation components with their inherent inflexibility. Conversely, when done incorrectly, this can lead to serious data integrity problems because of bad or obsolete data.

The presence of fourth generation software tools such as Focus or VisiCalc does not always indicate end-user computing. Many sites have fourth generation tools spinning on disks where they are rarely, if ever, accessed.

End-user computing, however, can be greatly facilitated by fourth generation software tools if they are understood and properly used. Such tools are fundamentally different from previous software tools, with new and varied capabilities. Three distinctive features of the fourth generation software tools are:

- a facility to describe data outside the processes that use the data;
- an assumption on the underlying data design permitting the generation of procedural logic based on nonprocedural descriptions;
- an assumption on the underlying technical architecture providing a place to "put" generated logic.

The need for description of data is not obvious to the end user. For instance, users don't see why it is important to the computer that a field, such as order number, is 10 characters long, or why it is equally significant that order amount is found in a record prior to order cost. For these reasons, most fourth generation tools provide some means to describe data externally. The facility can be used by a dp person to define initial detail descriptions of data that the user can then access in a variety of ways.

A more subtle point of an assumed underlying data design is that fourth generation software is built upon the principle that data structure implies program structure. As a result, one can find report writers that extract from flat files, hierarchical files, or network structures, but it's rare to find efficient hierarchical report writers that can cope with network data structures and flat file report writers that can deal with hierarchical files. Similarly, many on-line generators can cope with a single record per screen but have problems with multiple records. Or, numerous spreadsheet handlers assume that the application requirements can be mapped into a matrix data structure. The point is that program generators are built explicitly or implicitly around an assumed data structure, and it is essential to understand these structures.

The software also makes a set of assumptions about technical architecture. Is it batch or on-line? If on-line, is it conversa-

tional? If conversational, will it protect records across exchanges? If batch, can it be invoked by the user program? The user and/or coach must be aware of the assumptions.

Yet the need for awareness seems to contradict the concept of fourth generation software. Why is it necessary to be aware of assumptions when the software is supposed to free users from computer concerns? In the beginning, one can stay within the assumptions because of the simplicity of initial efforts. But with experience, the end user becomes confident and desires to do more. Eventually, unless the assumptions of the tool are understood, they will be violated, making the tool counterproductive. When this occurs, one must wait for the mythical "next release" of the tool, or stop doing whatever created the problem.

### FOURTH GEN TOOLS USEFUL

Fourth generation tools are prevalent in end-user environments. They provide large productivity gains when requirements conform to the design assumptions of the product. They also provide productivity disasters when the data and architecture assumptions are ignored or misunderstood by end users and their coaches.

Does the basic nature of systems development change in an end-user computing environment? Practitioners in the field consistently say yes. Over the last year, I worked on a project that evaluated the suitability of classic methodologies for an end-user environment. The model we used identifies six major phases in an end-user environment systems development:

- define functional requirements—establishes what the system is expected to do;
- define data design—develops a data design to support the system, based on functional requirements;
- design technical architecture—describes the system's major processes and how they interrelate;
- system design—delineates the system based on data design and technical architecture;
- implementation—transforms the system design into a machine-executable format;
- testing—ensures the system performs the expected functions.

In our model, data design precedes and largely dictates system design. Such a methodology is referred to as a data-structured development methodology.

We found that the evolutionary development approach and fourth generation tools used by most end users implied some fundamental changes to the development process as described in the data-structured methodology. First, functional requirements are not defined in end-user computing; rather, the

question is what data are needed. This question is not the typical functional requirements view. Second, in data-structure methodology, the database design is driven by how the user will use the system. In end-user environments, these functional requirements are not available before the system is designed, but instead evolve with the system. As a result, we could not do data design as typically defined in a data-structured methodology. Finally, technical architecture and system design are driven from the data design, which, of course, is not available.

Fourth generation languages impose a data design on the user as well as a technical architecture. These two observations proved key in defining a development methodology for end users. The first point means that rather than do a data design, one should understand the language's underlying data design assumptions and fit requirements into this data design. And, rather than design a technical architecture for a fourth generation language, the objective should be to fit the design to the technical architecture provided by the language.

### ACCESS TO EXPERT IN LANGUAGE

The successful user of a fourth generation language should have access to an expert in the language—ideally the coach mentioned earlier. The coach's knowledge and experience are central to the effort's success.

A methodology for end-user computing was established in the project; it is iterative in nature with great emphasis on user involvement in fitting requirements to the fourth generation tools' assumptions.

We have had enough dp experience to know there are no general solutions to all the problems. End-user computing is one more way to get information to the people who need it. As such, it offers an exciting opportunity, but we must be aware of the problems. Certainly, end-user computing provides real benefits. If it is to succeed, a few key moves must be made initially, which will lead to long-term success in this new and fascinating field. ●

Hugh Ryan is a partner with Arthur Andersen & Co. He joined the firm in 1971 with a master's in mechanical engineering. Over the last six years he has concentrated on structured methods for software engineering.

#### REPRINTS AVAILABLE

Reprints of all DATAMATION articles are available in quantities of 100 or more. Details may be obtained by telephoning Mary Ann Hariton, (212) 605-9729.



# Hard Facts on Hardware Service

*In that old bluegrass song, "The Arkansas Traveler," the old man fiddled in the sun all day, said he didn't need to fix his roof until a rainy day. Try that piece of homespun wisdom with the new computer system you just bought, or are about to buy, and you are liable to take a very costly bath indeed. John Butler offers some very practical advice about options available for the care and repair of computer hardware guaranteed to benefit end users, big and small.*

In deciding to purchase a desktop computer, many people often overlook one very important consideration—hardware maintenance. The reason for this oversight stems usually from one of two sources: the purchaser is a first-time computer user who fails to realize how much s/he will come to rely on the system; the person believes the particular system is such a world-beater that s/he cannot conceive that it could ever possibly break down. While desktop computers are much more reliable than their predecessors, they do sometimes fail. And when they do, service becomes an important consideration.

Unfortunately, not everyone realizes the importance of considering service until the computer fails—and then it is often too late. Therefore, we must consider the question of when should you think about service.

## Planning ahead

The best time to consider service is before you buy a computer. First of all, after a tentative selection of a particular system has been made, you would want to find a service organization that will handle all of the products you have chosen. Say, for example, if you find that there is no service available for the particular printer that you had in mind, you may want to go with an alternative for which there is service available. Another point to consider is that you will find it easier to deal with one service organization. So, if possible, select all of the components with an eye toward total service through one vendor.

If you have already purchased your computer, the best time to think about service is now. If you wait until your system fails, you may wind up taking a form of service that is unsuitable to your needs and very costly in the long run. The time to locate a fire extinguisher is before the fire.

Also, if you put off the matter of service until after your system breaks down, your system is likely to stay down for a considerable period of time.

There are four main types of service available to the end user: (1) carry-in service, (2) mail-in service, (3) self-service, (4) on-site service.

Which of the four is best for you depends on a number of factors. Can you afford to be without your computer for any length of time (up to four weeks on some mail-in service)? Can you afford to pay for on-site service? Can you transport your system to the nearest repair facility? Are you qualified, and do you have the time, to repair the system yourself? There are other factors to consider but these should set you thinking along the right lines.

## Carry-in service

Typically, carry-in depot contracts are 35 to 50 percent less expensive than an on-site contract. You can also pay for carry-in service on a per-incident basis, which may be less expensive in the beginning but become more expensive in the long run. The majority of carry-in service can be completed, while you wait, in two hours or less, although some problems may require leaving the equipment overnight.

The major drawback to carry-in service (as with mail-in service) is that you must determine which unit (central processor, disk drive, printer, video display unit, tape drive, and so on) is failing. This is usually easy to determine, but in some cases it can be very confusing. For example, if when you try to load the operating system (boot the system) nothing appears on the screen, is the failing unit (1) the system disk? (2) the disk drive? (3) the central processor? (4) the video display? or (5) a cable?

Occasionally, a video display, or printer, or disk drive can affect another unit in

the system because they are all connected to the central processor and are interactive. In certain cases, an attached unit can even damage another unit.

While the problems I have pointed out may not be very common ones, they do occur, and you should be aware of them.

## Mail-in service

This service is even less expensive than carry-in service. You must determine which unit is defective, usually to the point of the defective circuit board or major mechanical assembly, and then ship it directly to a depot or to the manufacturer. This service can be charged at a yearly rate for a contract or at a flat rate for the particular unit returned. This flat rate remains the same, even if you end up sending a good unit to the manufacturer, because they will still have to charge you to test the item sent. If you are paying for an annual contract, the only additional charge will be the cost of shipping it to the depot. The repair depot will normally include return shipping in the price of the contract, unless you request special freight or air service.

If you do not have an annual contract for mail-in service, the depot will require that you call them to get a shipping authorization number prior to sending anything to them. Without this authorization they may refuse to accept the package. The depot will normally tell you what the charge will be for their service in advance so that payment can be enclosed with the defective part, unless billing has been arranged in advance.

With mail-in service the most important factor to consider is time. If you figure on three days to ship the unit each way and add the time to process your part and make the repair (this can take from one day to four weeks), it is easy to see the drawback to this type of service. The bottom line, however, is that you can save



money—provided you can do without the system for some length of time.

You can also save time and money by shopping around for the mail-in depot that is closest to you. This saves you shipping time and costs. With the development of third-party repair depots nationwide, this becomes an even more desirable option because they are all competing for your business, which brings the level of service up while driving the cost down.

### Self-service

If you, or someone you know, can service the system safely (remember you are dealing with potentially hazardous voltages of up to 12,000 volts once you remove the covers), then you can save money by making your own repairs. With self-service your cost is limited to replacement parts plus your time, but you must consider if you can afford to leave your normal duties while you repair a computer, and who might repair the computer when you are out of town or out sick. Another point to consider is the availability of spare parts.

Self-service is normally best suited to the home hobbyist who enjoys working on his system and whose business is not tied to the computer.

### On-site service

This is the most costly of the four categories (typically one percent of the list price of the equipment per month). A common desktop computer that sells for \$3,600 costs \$36 per month for an on-site service contract. For this price you are entitled to have a field engineer come to your location and make all needed repairs. All parts, labor and travel (if you are within the service area) are included.

On-site service is usually best suited to businesses that rely heavily on their computers. Such users need their systems up and running because they will simply be losing too much money when systems are down. The cost may appear high, but when you consider that you receive technical and parts support as well as the fastest repair possible, the price is quite reasonable.

When evaluating on-site service options, there are several factors to keep in mind. The price for on-site service is higher than for other types, so you should be sure you are receiving good value for your money.

1. *Parts support.* Does the field engineer/technician carry a supply of common-use parts with him? If so, he can usually fix your computer rapidly, often in under

an hour. If not, he must order the required part and make a second trip to complete most repairs. This is the difference between getting the computer up in hours rather than days.

If you need a part that the field engineer does not carry with him, how fast can he get it? This is a measure of the depth of the parts support that you will get. Some companies will normally be able to get an emergency part delivered to the field engineer overnight.

2. *Response time.* This is measured in two ways. First, when you place a service call, how long will you have to wait for your field engineer to call you back? Many problems can be resolved with a phone call. If you get a phone response from your field engineer within an hour, you may be back up and running in another hour.

Second, after you call for service, how long will you have to wait before the field engineer arrives at your location ready to begin the repair? This could vary from as little as a few hours to the next day or even longer.

3. *Technical support.* Even the best field service personnel are stumped by a problem from time to time. In such an instance, is there a technical support group to back up the engineer?

4. *Education.* How does the service company train its field engineers and update such training as new products and developments in computer technology come on the market? Obviously, you want a qualified field engineer to respond to your problem, and nothing shatters your confidence more than the field engineer who walks in and announces, "I've never seen one of these things before, but I'll do my best."

5. *Tools.* Does the field engineer carry an oscilloscope with him? Some problems can be fixed by a simple adjustment (disk drive head alignment for one), but to do this an oscilloscope is required. Can he get an alignment disk or other special equipment if needed?

6. *Diagnostics.* Can the field engineer run diagnostics to identify failing components and solve intermittent problems?

7. *Full service.* Does the service company service the entire system? Some companies will service the central processor, but if you have a printer or a video display that is made by someone else, they often cannot service them. In practice, it is much easier for you, the user, to deal with one and only one service vendor.

The benefits are immediate and obvious.

When you have a problem, you do not have to determine which component in the system is at fault. If the printer prints incorrectly, it is probably the printer that is at fault, but in some instances the central processor or even the disk drive could be the cause of your problem. If initially you call the printer people for a problem caused by your central processor, you eventually will have to call the central processor people. The printer service company will then have the option of charging you for a service call not connected with a problem in your printer.

8. *Preventive maintenance (PM).* You need not wait for your system to break before calling for service. Often a problem can be prevented from surfacing through the proper preventive maintenance program.

A good example of the value of preventive maintenance involves a small manufacturing firm in New Hampshire, which had purchased a desktop computer with an 18-megabyte hard disk drive. After 18 months of trouble-free operation, disk problems developed, and a field engineer was called in. Results: the disk drive was replaced at a cost of \$1,700 plus labor at \$72 per hour. The cause of this financial disaster: a two-inch by two-inch filter that had become clogged with dust and caused the disk drive to overheat. This is one problem that could have been avoided completely by the proper preventive maintenance program.

9. *Size of the service force.* How many field engineers does the company have in your area who are trained to work on your system? While it is comfortable to deal with the same field engineer, it is apparent that no one is at work every day of the year. Vacations, sicknesses, accidents, and so forth all take field personnel out of the field at one time or another. Also, when your regular field engineer is working on someone else's emergency when you need him, is there adequate back-up or will you simply have to wait?

The depth of the service organization with which you are dealing is a direct indication of how reliable their service will be.

10. *Mileage charge.* Will the service company charge you extra because you are beyond its service area? Remember, not all service companies have the same area of service coverage.

11. *Inspection fee.* Some service companies charge you to inspect a system to determine if it is eligible for a maintenance contract, while others make no charge for such inspections.

**Service contracts**

As indicated earlier, you usually have a choice of paying a fee (monthly or annually) for a service contract, or paying a per-incident charge each time you need service. The plan you choose, of course, depends on your situation, but it is clear that you will, in the long run, pay more for per-incident service than you will pay for an annual contract.

Operating on a per-incident basis, service companies cannot plan ahead adequately, and thus they will have to keep on hand more parts and more personnel than necessary, or they will have to make customers wait for service. Therefore, the service company has a very clear, vested interest in your choosing a service con-

tract. As such, they will price the contracts versus per-incident charges so that you will be induced to take out a contract, allowing them to operate on a more stable—and hence profitable—basis.

If you only use the system on a very limited basis, say, as a hobbyist, then it may be best for you to go with a per-incident plan. If you plan to use depot service (either mail-in or carry-in), you should realize that, in most cases, you will have to come up with a large, one-time fee in advance in order to use the per-incident plan of payment.

If you wish to use on-site service and pay on a per-incident basis, be aware that not all service companies allow this. Some will only service your computer

on-site with a contract, or if you agree to purchase a contract after the first per-incident call.

Two final matters to consider with service contracts concern adequate notice—on the company's part or on your own—of cancellation of the contract and of planned rate increases. In both cases, the common practice in the data processing industry is 90 days. Your service company should match this practice and state it in the contract. □

---

*The author is a field engineer with MAI/Sorbus, an independent service organization. Address any correspondence to him c/o Desktop Computing.*

---



# INSECURITY IN NUMBERS

By Fred W. Weingarten

**G**OVERNMENT EXECUTIVES have long been warned that their agencies' computerized data systems need to be protected. Federal computer center directors have fought a continuing battle to focus high-level attention on threats against agency information resources and to obtain funds for computer security. Besides having to cope with a skeptical bureaucracy, they have had to adapt to constantly changing technology. Yet despite the relatively slow pace of much Federal EDP procurement, new applications are constantly being installed, and each change brings the potential for new threats, vulnerabilities and losses.

Now, just as Federal agencies seem to be heeding the call to secure their data operations, another technological revolution is taking place: automated office systems. First as word processing, now as desk-top computers, information technology is moving out of the traditional domain of the operations center. Whether via smart terminals connected to a central mainframe, terminals linked to a shared minicomputer, or ubiquitous desk-top computers, data processing power is moving into the hands of office users.

This trend poses completely new security and data control problems to agencies. And there is a new need to develop hardware and software products to protect the new system architectures. An even more challenging problem is developing appropriate manage-

*Fred W. Weingarten is program manager, communications and information technologies at the Office of Technology Assessment, which is the analytical arm of the Congress.*

---

*Now, just as they've  
heeded the call to secure  
their data operations,  
Federal agencies are  
confronted by completely  
new data control problems  
posed by distributed  
office automation.*

---

ment and operational controls for automated data processing that is physically distributed over an entire agency.

It cannot be too soon to think about these problems; later on, when computers become common office tools, and when applications, bureaucratic procedures and habits are set, establishing controls will be much harder to impose and enforce.

Along with the rapidly increasing number of small office machines, capabilities are also expanding. Sixteen-bit machines, such as the IBM PC, which, offer substantially more computing power, are beginning to replace the "first generation" eight-bit models such as the Apple II and III. Inexpensive hard disk storage systems are also now becoming available for small systems. For a few thousand dollars, a user can add tens of millions of bytes of on-line disk storage to a desk-top computer.

The software marketplace for small business machines is also growing. Publishers are creating increasingly elaborate spread sheet, word processor, and data-base systems—programs that until

now have amazed users merely by being available for small systems. The latest fad is to integrate these various packages to provide elaborate work stations used for performing quantitative analyses, searching data bases and preparing reports.

Perhaps most importantly, communications technology is moving rapidly, motivated by both deregulation and innovation. At the office level, computer vendors are developing local area networks (LANs), through which desk-top computers can communicate with one another, with the office word processors and with an agency's main computer system.

And new regional, national and international data communications services are being developed that can link desk-top computers with information systems anywhere in the world.

Sixteen-bit desk-top computers now on the market will be challenged by 32-bit models in just a few years. And there is reason to expect that by the turn of the century, an inexpensive desk-top computer will have the power of the largest computers of today. Data communication paths capable of carrying several hundred thousand baud will be commonplace, as will on-line data storage systems (optional disk or bubble memory) that contain billions of bytes of data.

**F**ACED WITH these trends, and assuming the Federal Government follows private sector fashion and becomes a major user of small systems, the security problems confronting Federal ADP executives will be enormous. Problems will be both technological (as computers and communications sys-



tems change) and administrative (as traditional lines of authority and control are altered).

• **As costs for hardware and software drop and users become more sophisticated, the number of applications will increase dramatically.**

Greater use means that security analysis will have to account not only for an increase in sheer volume of information to be protected, but for new types of information that will be collected to support new applications. New applications will come about because the decreasing cost of computing will make them cost-effective; more users will think up new uses; and the trend toward office automation will reinforce pressures for increasing productivity.

• **Office automation will bring new legal requirements for protecting electronic documents and data.**

Security experts are used to performing risk analysis on automated systems that handle financial or personal data. But desk-top systems add a new element to their calculations. The professed ultimate goal of office automation enthusiasts is the "paperless office," in which all or most documents are electronically kept on floppy disks, hard disks or other electronic media. Our experience is limited with threats to and vulnerabilities of this type of data.

Clearly, compromise of electronic office information would be painful to an agency, to its employees and to its clients. Law and regulation require that agency correspondence and administrative documents be kept and protected for specific lengths of time. If a controversy arises, an agency may be required to establish the authenticity of a record. But the courts are still struggling with the status of electronic records as evidence.

For years, the media have reported that stolen memos, letters, draft reports and the like have been and can be used to attack an agency's actions and decisions. Are electronic files more or less subject to such leaks?

There will also be new situations when internal access to documents must be carefully controlled, so employees cannot see, copy, or alter files created by other employees.

• **Administrative and procedural controls will be made more difficult by decentralized use.**

Many central computer centers have lived in a state of uneasy truce with their users. Control of information, considered a source of bureaucratic power, has traditionally resided in the comput-

er center. Distributed office automation systems now offer the chance for users to capture some of that power.

Despite the bureaucratic merits of centralized data control, there is no question that the central computer center can still be the focus for establishing and enforcing a strong security policy. But data controls that are practical for a centralized system may be inappropriate in a distributed environment. Rules for the handling of disk files or physical access restrictions do not belong in the average office environment.

Many users will resist rigid controls that inhibit how they use their systems or what they use them for. Given current unprecedented technological opportunities, many users will want to assert their own tastes in word processing software or data base management systems. Those decisions used to be made by the computer operations staff; now they will be in the hands of the comput-

---

*Few users of desk-top computing realize the risks they and their agencies face as a result of how they use their new systems.*

---

er users. Wrestling back control may be a difficult task once users have tasted freedom.

In some cases, it may not be in an agency's best interest to give in to the natural desire to reassert central authority. The conflict is between the benefits of flexibility, convenience and direct user access that characterize small computers and the need to continue central control over use of technology. Insisting on controls may counteract the benefits of the new systems.

Perhaps most importantly, it may be technically and administratively impossible to enforce controls on distributed desk-top systems. Power is in the hands of the users; computers are in offices and on desks. Unless users perceive self-interest, they may disregard rules that proscribe certain types of use, standardize systems, define the types of data that may be stored, and establish control procedures over system use.

Short of bursting into an office unannounced with a surprise audit or shuffling through desk drawers in an employee's absence, enforcement may be impossible.

Ultimately, workers who feel that

computers could substantially help them (but that administrative controls stand in the way of those benefits) have the option of using a computer at home.

**EXHORTATION 1: Account for office automation and desk-top computing in the security analysis.**

This task only sounds simple. The computer operations staff may be the last to know about or have any responsibility for office automation or desk-top procurements. Computers are sneaking in the back door as increasingly intelligent typewriters and calculators—devices for which computer operations have never had previous responsibility.

Even if the computer center security group has access and authority to examine office automation applications, a new world of vulnerabilities and potential losses confront them.

Regardless of administrative and technical difficulties, it remains important for an agency's data security assessment to include the desk-top computer, and designate someone to start worrying about it.

**EXHORTATION 2: Stress organization aspects of controls.**

Technological controls on small computers and office automation are not likely to be immediately useful for providing security. Data processing security analysts are likely to find that their biggest problem in any risk assessment is dealing with bureaucratic resistance. Controls should be carefully designed to accommodate office clerical and administrative staff.

Employee training is an essential part of any security program. Rather than deal with the relatively few programmers in a central facility, a security program that covers desk-top systems must educate thousands of users, each running their own machine. Few of those people have any idea of the risks they and their agencies face as a result of how they use their new systems.

**EXHORTATION 3: Start now, while the problem is tractable.**

Not all Federal offices are automated. And many of those using desk-tops and word processors have not yet adopted sophisticated technology such as shared systems. Local area networks are just starting to appear. Security analysts have the opportunity to put administrative controls in place now before bad habits become embedded, before office products in the same agency diverge, and before new applications (not in an agency's long-term best interests) can be installed and incorporated in office operations. □



## APPENDIX

This selected readings was compiled from the following magazines and journals from December 1982 through January 1984.

Business Computer Systems

Cahners Publishing Company, 221 Columbus Avenue,  
Boston MA 02116

BYTE

70 Main Street, Peterborough, NH 03458

Computerworld

CW Communications/Inc., Box 880, 375 Cochituate  
Road, Framingham, MA 011701

Creative Computing

PO Box 789-M, Morristown, NJ 07960

Datamation

875 Third Avenue, New York, NY 10022

Desktop Computing

Ceased publication, December 1983

Government Data Systems

475 Park Avenue South, New York, NY 10016

Hardcopy

187 W. Orangethorpe Avenue, Suite 1A,  
Placentia, CA 92670

InfoWorld

530 Lytton, Palo Alto, CA 94301

LIST

Redgate Publishing Company, 3407 Ocean Drive,  
Vero Beach, FL 32960

Mini-Micro Systems

221 Columbus Avenue, Boston MA 02116

PC World

555 De Haro Street, San Francisco, CA 94107

Personal Computing

50 Essex Street, Rochelle Park, NJ 07662

Popular Computing

70 Main Street, Peterborough, NH 03458

Softalk

11160 McCormick Street, North Hollywood, CA  
91601

Systems and Software

50 Essex Street, Rochelle Park, NJ 07662

80 Micro

80 Pine Street, Peterborough, NH 03458



U.S. DEPT. OF COMM. <b>BIBLIOGRAPHIC DATA SHEET</b> (See instructions)		1. PUBLICATION OR REPORT NO. NBSIR 84-2878 (R)	2. Performing Organ. Report No.	3. Publication Date May 1984
4. TITLE AND SUBTITLE Selected Articles on Microcomputers				
5. AUTHOR(S) Lynne S. Rosenthal				
6. PERFORMING ORGANIZATION (If joint or other than NBS, see instructions)  NATIONAL BUREAU OF STANDARDS DEPARTMENT OF COMMERCE WASHINGTON, D.C. 20234			7. Contract/Grant No.	8. Type of Report & Period Covered
9. SPONSORING ORGANIZATION NAME AND COMPLETE ADDRESS (Street, City, State, ZIP)  SAME AS ABOVE				
10. SUPPLEMENTARY NOTES  <input type="checkbox"/> Document describes a computer program; SF-185, FIPS Software Summary, is attached.				
11. ABSTRACT (A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here)  An abundant amount of information is being written about microcomputers and its related products. The reader is often overwhelmed at where to begin. This document provides the reader with basic microcomputer information and provides a starting point for further examination of the subjects. The readings cover a broad range of topics including management and technical aspects of hardware, software, communications, and support.				
12. KEY WORDS (Six to twelve entries; alphabetical order; capitalize only proper names; and separate key words by semicolons)  Communication; Management; Microcomputer; Micro-Mainframe Connection; Personal Computers; Selection; Software				
13. AVAILABILITY  <input type="checkbox"/> Unlimited <input checked="" type="checkbox"/> For Official Distribution. Do Not Release to NTIS <input type="checkbox"/> Order From Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.  <input type="checkbox"/> Order From National Technical Information Service (NTIS), Springfield, VA. 22161			14. NO. OF PRINTED PAGES	
			15. Price	













